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The Engineer

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PUBLIC NOTICES

The High Commissioner for India is prepared to receive TENDERS for the SUPPLY of :—
WIRE, COPPER, TELEGRAPH.
CABLE, ELECTRIC, V.I.R. INSULATED.
Forms of Tender may be obtained from the Director-General, India Store Department, Belvedere-road, Lambeth, S.E. 1, and Tenders are to be delivered at that office not later than Two o'clock p.m. on Friday, the 9th June, 1922.
T. RYAN,
Director-General.
8223

Assistant Engineer Re-QUIRED by the GOVERNMENT of NYASALAND for one tour of 20 to 30 months, with possible permanency. Salary £400, rising by annual increments of £20 to £500 a year, and thence by annual increments of £25 to £600 a year. Outfit allowance of £30 paid on first appointment. Free first-class passage and quarters. Candidates, preferably single, age under 30 must be A.M.I.C.E. or hold equivalent professional qualifications. Must have had good experience on road survey and construction, also experience in design and erection of steel and timber bridges and buildings of a simple kind, and be able to ride a motor cycle.—Apply at once, in writing, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting M/Nyasaland 11,456. 8189

SALE BY TENDER.

G. R.

BOARD OF TRADE.
BY ORDER OF CONTROLLER, TIMBER DISPOSAL DEPARTMENT.

AERIAL ROPEWAY,
KINGSLAND STATION, HEREFORD.

To be Sold by Private Tender, the AERIAL ROPEWAY at KINGSLAND STATION, as and where standing.
TOTAL LENGTH ABOUT 3¼ MILES.
Trestles or standards, 63 in number, from 16ft. to 60ft. in height, built of angle iron in sections of 6ft. lengths by 2ft. 6in. square. The ropeway is worked by a 12 H.P. PORTABLE ENGINE, which may be included in the offer or left out.
All the spare sections or parts of the ropeway lying at Kingsland unloading station or at the loading station are included.
Offers for above ropeway, with or without engine, will be received by ACTING CONTROLLER, 49, Wellington-street, London, W.C. 2, up to and including May 25th, 1922.
The highest or any offer will not necessarily be accepted. 8105

City of Nottingham.
The Works and Ways Committee are prepared to receive TENDERS for the SUPPLY of the undermentioned STORES and MATERIALS, the contracts to commence on the 1st July next, and to terminate on the 31st December, 1922 :—
A.—Cement.
B.—Blue Lias Lime.
C.—Red Bricks.
D.—Blue Bricks.
E.—Timber.
F.—Stoneware Pipes, &c.
G.—Stoneware Pipes, &c. (Patent Joints).
H.—Iron Castings, Iron Gullers, &c.
I.—Yorkshire Flags, Kerb, &c.
J.—Granite Setts, Kerb, and Broken Granite.
K.—Ironstone Slag, Chippings, &c.
L.—River Gravel.
N.—Picks, Shovels, Scoops, &c.
O.—Ironmongery.
P.—Scavenging and other Brushes.
Q.—Disinfectants.
R.—Refined Tar.
S.—Pitch.
T.—Creosote Oil.
Forms of Tender may be obtained on applying to Mr. T. Wallis Gordon, Acting City Engineer, Guildhall, Nottingham, on payment of a deposit of 5s. each, which will be returned on receipt of a bona fide Tender in accordance with the specifications, providing such Tender is not withdrawn and is delivered by the time stated below.
Patterns and samples may be inspected at the Eastcroft Depot, London-road, Nottingham.
The Committee will not consider any Tender except on the authorised form of Tender, which must be delivered to the undersigned, in the official envelope provided, on or before Thursday, 8th June, 1922.
The lowest or any Tender will not necessarily be accepted, and Tenders will only be accepted from persons who conform to the conditions as regards paying the local standard rate of wages, &c., and to the working rules of the Nottingham district applicable to the various trades.
By Order,
W. J. BOARD,
Town Clerk.
Guildhall, Nottingham,
12th May, 1922. 8181

County Borough of Croydon.
SURREY-STREET WATERWORKS.
TO ENGINEERS.
Notice is hereby given that the Council are prepared to receive TENDERS for the SUPPLY, FIXING and SETTING to WORK of a STEAM PUMPING ENGINE at the Surrey-street Waterworks. Specification, conditions and form of Tender may be obtained on application at the Borough Engineer's Office, Town Hall, Croydon, upon payment of a deposit of One Guinea, which will be returned upon receipt of a bona fide Tender.
Tenders, on the prescribed form, to be sent to me by Eleven o'clock in the forenoon of Saturday, the 1st day of July, 1922, endorsed "Tender for Pumping Plant, Surrey-street Waterworks."
Tenders will only be received subject to the terms of the draft contract and conditions deposited at my office and which may be inspected during office hours.
The Council will not be bound to accept the lowest or any Tender.
JOHN M. NEWNHAM,
Town Clerk.
Town Hall, Croydon,
15th May, 1922. 8184

The National Foremen's Asso-CIATION of the
ENGINEERING AND ALLIED TRADES.
(Registered under the Trade Union Act.)
An Association specifically formed to look after the interests of Foremen in their Supervisory Capacity.
All communications to Head Office :—
H. W. REID, 95, Belgrave-road,
General Secretary. Victoria, S.W. 1.

PUBLIC NOTICES

Metropolitan Water Board.
TENDERS FOR THE SUPPLY AND FIXING OF STEEL STEAM PIPES AND VALVES AT KEW BRIDGE WORKS.
The Metropolitan Water Board invite TENDERS for the SUPPLY and FIXING of WROUGHT STEEL STEAM PIPES with STOP VALVES at their Kew Bridge Works, Brentford, Middlesex.
Forms of Tender, conditions of contract, specification and drawing may be inspected without payment of fee at the offices of the Board (Room 182), 173, Rosebery-avenue, Clerkenwell, E.C. 1, on and after Tuesday, 23rd May, 1922.
Contractors desirous of tendering may obtain the necessary documents from Mr. Henry E. Stillcox, M. Inst. C.E., the Chief Engineer, on production of an official receipt for the sum of £1 1s., which sum must be deposited with the Board's Accountant and will be returned on receipt of a bona fide Tender, together with all incidental papers.
Such payments and applications must be made between the hours of 10 a.m. and 4 p.m., Thursday excepted (Saturdays, 10 a.m. to 12 noon).
Tenders, enclosed in sealed envelopes, addressed to "The Clerk of the Board, Metropolitan Water Board, 173, Rosebery-avenue, E.C. 1," and endorsed "Tender for Steam Pipes, Kew Bridge Works," must be delivered at the offices of the Board not later than 10 a.m. on Wednesday, 31st May, 1922.
W. MOON,
Clerk of the Board.
Offices of the Board,
173, Rosebery-avenue, E.C. 1,
May, 1922. 8205

Metropolitan Water Board.
The Metropolitan Water Board invite TENDERS for the SUPPLY, TESTING, and SETTING to WORK of a STEAM-DRIVEN LOCOMOTIVE SHUNTING JIB CRANE of 4 to 5 tons capacity, at the Batterees Pumping Station (South Lambeth Sidings, G.W. Ry.).
Forms of Tender, conditions of contract, &c., may be obtained on application at the offices of the Board (Room 156), 173, Rosebery-avenue, E.C., by personal application or upon forwarding a stamped and addressed brief envelope. Tenders, enclosed in sealed envelopes, addressed to "The Clerk of the Board, Metropolitan Water Board, New River Head, 173, Rosebery-avenue, E.C. 1," and endorsed "Tender for Loco. Crane," must be delivered at the offices of the Board not later than 10 a.m. on Friday, 2nd June, 1922.
The Board do not bind themselves to accept the lowest or any Tender.
W. MOON,
Clerk of the Board.
Offices of the Board,
New River Head,
173, Rosebery-avenue,
Clerkenwell, E.C. 1,
16th May, 1922. 8230

Ventnor Urban District Council.
REPAIRS TO TIE RODS, &c., TO THE ROYAL VICTORIA PIER AND LANDING STAGE.
The Ventnor Urban District Council invite TENDERS for the REPAIR and REPLACEMENT of a number of TIE RODS and other IRONWORK to the understructure of the Royal Victoria Pier and Landing Stage, Ventnor.
Plans, sections and specification may be seen at the office of Mr. D. V. Howard, the Engineer and Surveyor to the Council, Town Hall, Ventnor, I.W.
Tenders, sealed and endorsed "Pier Repairs," to be delivered to the undersigned not later than Noon on the 7th day of June, 1922.
The Council do not bind themselves to accept the lowest or any Tender
(Signed) JAMES WEAVING,
Clerk to the Council.
Town Hall, Ventnor, I.W.,
May 10th, 1922. 8149

PUBLIC NOTICES

Parish of Lambeth.
BOARD OF GUARDIANS.
The Guardians of the Poor of the Parish of Lambeth hereby invite TENDERS for the PROVISION and INSTALLATION of ELECTRIC LIGHT WIRING and FITTINGS at the Lambeth Hospital, Brook-street, Kennington, S.E.
Printed forms of Tender (which alone will be received), with conditions annexed, together with specification, may be obtained at this office on any day (except Saturday), between the hours of Ten and Five, upon payment of £2 in respect thereof, which will be returned to each person sending in a bona fide Tender. The drawings may be inspected at this office, and copies thereof may be obtained upon payment of the sum of 1s.
The Tenders, which must be sealed and superscribed in accordance with the instructions set forth on the form of Tender, must be sent to the undersigned or placed in the box provided for their reception in the office of the Clerk to the Guardians by the tenderers or their representatives, should they so desire, on or before Tuesday, the 30th inst., and will be opened in the Board Room at noon on the following day, when all persons tendering or their authorised agents should be in attendance.
The Guardians do not pledge themselves to accept the lowest or any Tender.
By Order,
JAMES L. GOLDSPINK,
Clerk to the Guardians.
Guardians' Board Room and Offices,
Brook-street, Kennington-road, S.E. 11,
11th May, 1922. 8179

Tenders are Invited by the Government of New South Wales for the CONSTRUCTION of the SUPERSTRUCTURE and SUBSTRUCTURE of a CANTILEVER BRIDGE across Sydney Harbour from Dawes Point to Milson's Point, embracing a main span of 1600ft. in the clear, centre to centre of main piers or 2600ft. centre to centre of anchor piers. The total length of bridge included in Tender is 3816ft., centre to centre of abutments. The deck of the bridge is to include four lines of railway, and a roadway 35ft. wide, between main trusses; and cantilevered outside the main trusses on the western side, a footway 15ft. wide, and on the eastern side a motor roadway 18ft. wide. Copies of specification, including plans, general conditions and schedule of quantities may be obtained on application to the undersigned.
To give any information required by tenderers, Mr. J. J. C. Bradfield, Chief Engineer, will be in London during June and July, 1922, address care of the undersigned.
Tenders in accordance with the specification must reach the Under Secretary for Public Works, Sydney, not later than 31st October, 1922.
AGENT-GENERAL
FOR NEW SOUTH WALES.
Australia House, Strand, London, W.C. 2,
December, 1921. 7838

The Metropolitan Asylums Board invite TENDERS for the OPENING UP, REPAIRING and CLOSING UP of the ENGINES, &c., of the RIVER AMBULANCE STEAMER "RED CROSS," in accordance with the specification prepared by Mr. Thomas Cooper, M.I.C.E., Engineer-in-Chief to the Board.
Specification, conditions of contract, and form of Tender may be obtained at the office of the Board, Embankment, E.C. 4.
Tenders, addressed as noted on the form, must be delivered at the office of the Board not later than 10 a.m. on Monday, 29th May, 1922.
DUNCOMBE MANN,
Clerk to the Board.
12th May, 1922 8204

PUBLIC NOTICES

Southampton Corporation
WATERWORKS.
TENDERS FOR CAST IRON PIPES AND SPECIALS AND FOR LAYING THE SAME.
The Corporation invite TENDERS :—
(1) For the SUPPLY and DELIVERY of about 850 TONS of 21in., 20in., 16in., 15in., and 6in. SOCKET and SPIGOT PIPES and about 28 TONS of SPECIALS; and
(2) For the LAYING and JOINTING of about 4200 YARDS of the before-mentioned PIPES and SPECIALS.
Specifications, conditions, bills of quantities and forms of Tender may be obtained upon application at the Waterworks Engineer's office, 21, Shirley-road, Southampton, and the production of the Borough Treasurer's receipt for a deposit of One Guinea. Deposits will be returned, after the Council have dealt with the Tenders, to contractors who have submitted bona fide Tenders.
Sealed Tenders, suitably endorsed, must be delivered at the Town Clerk's office by the 31st instant.
No pledge is given to accept the lowest or any Tender or Tenders.
R. R. LISTHORNE,
Town Clerk.
11th May, 1922. 8178

State Electricity Commission of
VICTORIA.
TENDERS FOR PLANT.
TENDERS are hereby INVITED for the SUPPLY, DELIVERY, &c., of the following for the Morwell Power Scheme.
Copies of Tender forms and specifications will be available upon application to—
Agent-General for Victoria,
Melbourne-place, Strand,
London, W.C. 2.
SPECIFICATION No. 226.
ITEM 1.—5 SURFACE FEED-WATER HEATERS : 2 of 2250 sq. ft. surface, 3 of 1450 sq. ft. surface.
ITEM 2.—6 SURFACE VAPOUR CONDENSERS each 105 sq. ft. surface.
SPECIFICATION No. 227.
ITEM 1.—12 FEED-WATER EVAPORATORS, preferably of the marine type, supplied with steam at 40 lb. per sq. in., to operate in groups and multiple effect, four effects producing 12,500 lb. per hour.
CHARGE (in each instance).—£2 for the first two copies of Tender form, conditions of contract, specification and drawings complete. These charges will be returned on receipt of a bona fide Tender. A third copy and any further copies will be supplied for the sum of 10s. 6d. each.
PRELIMINARY DEPOSIT.—A preliminary deposit of £50 is to be lodged with Tender in each case.
The specification may be inspected at the above-mentioned office.
The Commission does not bind itself to accept the lowest or any Tender.
Tenders, on prescribed forms, properly endorsed and addressed, must be delivered to the undersigned in Melbourne not later than 5 p.m. on 1st September, 1922.
R. LIDDELOW,
Secretary,
State Electricity Commission of Victoria.
673, Bourke-street, Melbourne,
Victoria, Australia. 8212

NOTICE.
Colombo Municipality, Ceylon.
REQUIRED by the Municipal Council, Colombo, Ceylon, an ASSISTANT DRAINAGE ENGINEER.
Candidates must have passed the examination of the Associate Members of the Institution of Civil Engineers and have had a good experience of modern sewerage, sewage disposal and house connection work. They should not exceed 30 years of age and preferably be unmarried.
Appointment, on probation, three years, on a salary of Rs. 9000 per annum, with travelling allowance of Rs. 900 per annum; thereafter permanent, pensionable appointment on incremental basis guaranteed for efficient probationary service, with suitable leave.
Free first-class passage to Colombo and half-pay on voyage.
Application forms and full details can be obtained from the Council's London Agents, Messrs. John Fook and Co., 68, Fenchurch-street, London, to whom candidates should apply before May 31st, 1922.
E. H. JOSEPH,
Secretary,
Municipal Council, Colombo.
The Town Hall, Colombo,
March, 1922. 8202

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PUBLIC NOTICES

Shanghai Municipal Council.
PUBLIC WORKS DEPARTMENT.
CLERKS OF WORKS.

THREE fully qualified CLERKS of WORKS are REQUIRED in the Public Works Department. Candidates must be about 30 years of age, unmarried, and must be thoroughly competent to supervise the construction of new buildings. Salary, Taels 285 per month without allowances, under a three years' agreement, with a second-class passage from Home, half-pay on voyage, and free medical attendance. There is an excellent Superannuation Fund.

The value of the Tael at the present rate of exchange is about 3s. 4d., but it is liable to fluctuation. Taels 285 per mensem at exchange 3s. 4d. are equivalent to £570 per annum.

Particulars of the appointments may be obtained of the Council's Agents, and applications, with full information as to experience, &c., accompanied by copies of three recent testimonials, and endorsed "Clerk of Works," should be forwarded at the earliest possible moment to

JOHN POOK and CO.,
Agents for the Municipal Council of Shanghai,
68, Fenchurch-street,
London, E.C. 3.
May, 1922. 8203

SITUATIONS OPEN

THE BRITISH PETROLEUM CO., Ltd., Have to thank the applicants for the post of Works Engineer at Avonmouth, and to announce that the APPOINTMENT has now been MADE. 8211 A

WANTED, First-class DESIGNING DETAILER for Light Structural Work. Must be accurate, careful, fast and capable of taking complete charge of job. Test will be given. Good wages to good man.—Address, stating age, experience, and salary, 8239, The Engineer Office. 8239 A

WANTED, FOUNDRY MANAGER, Age Under 40; must be skilled Moulder and capable organiser. Willing to prove capacity by investing £1000 at 8 per cent. fully guaranteed.—Address, P5432, The Engineer Office. P5432 A

AN Established FIRM of REINFORCED CONCRETE ENGINEERS and CONTRACTORS are DESIROUS of APPOINTING REPRESENTATIVES in the principal districts of England and Scotland. Applicants with sound connections and some knowledge of this class of work, who are prepared to cover their ground thoroughly and systematically and accept remuneration on a liberal commission basis, are invited to send full particulars.—Address, 8214, The Engineer Office. 8214 A

ENGINEER.—WORKS SUPERINTENDENT REQUIRED, to Take Charge Small Works comprising Fitting and Machine Shops, Carpenters, &c., also Drawing-office and Foundry. Must be qualified engineer and eight o'clock man. Salary £6 per week.—Address, stating age and experience, P5411, The Engineer Office. P5411 A

FORGE SUPERINTENDENT, to Take Charge of modern Forge and Machine Shops. Previous experience of crank shaft manufacture essential.—Address, giving age, salary required, and references, 8199, The Engineer Office. 8199 A

FOUNDRY MANAGER WANTED for Modern Foundry in London district, with a capacity of 100 tons per week. A man of proved ability, who can produce castings at competitive prices, both by hand and machine, is required. Age, experience, and salary required must be stated.—Write, F. D., c/o J. W. Vickers and Co., Ltd., 5, Nicholas-lane, E.C. 4. 8223 A

GENERAL MANAGER.—WANTED, Smart, Energetic MAN, accustomed to control staff and workmen. Knowledge of Chemistry, Engineering, or Mining advantageous. Salary about £2000 per annum.—Send experience and testimonials to Box "V. F. V.," care of Davies and Co., 95, Bishopsgate, E.C. 2. 8177 A

HEATING ENGINEER, Young, Experienced, Designing and estimating.—Write fully to HENRY HOPE and SONS, Ltd., 59, Berners-street, W. 1. 8236 A

INDIA.—WANTED, SENIOR MAN, to ASSIST in MANAGEMENT of Large IRONFOUNDRY specialising in columns, girders, staircases, boiler and drum making and similar constructional ironwork. Only men of experience and ability need apply. Write, G. B. F., c/o Crossley and Co., Ltd., 5, Racquet-court, Fleet-street, E.C. 4. 8224 A

MANAGER'S ASSISTANT IN ENGINEERING FIRM.—WANTED, a GENTLEMAN of public school education, with good commercial experience and some engineering knowledge, to assist managing director. Permanent and progressive position to suitable man. Age 27-30.—Address, 8200, The Engineer Office. 8200 A

MANAGER REQUIRED to Supervise Large Saw Mills in India with native workmen. Thorough experience in Valuing, Buying, and Economical Conversion essential. Remuneration partly by salary, partly by profits.—Address fully in first instance by letter, 8190, The Engineer Office. 8190 A

QUALIFIED ENGINEER REQUIRED for British Engineering Company in Java. Thorough knowledge of Constructional Steel Work Designing essential. Commercial experience an advantage. Give full particulars in letter of application.—Address, 8191, The Engineer Office. 8191 A

SALES ENGINEER REQUIRED, to Take Charge of Plant Sales of Large Electrical Engineering Manufacturing Firm in India. First-class experience in heavy plant work and sales experience essential.—Address, 8206, The Engineer Office. 8206 A

SALESMAN WANTED, to Represent Firm Manufacturing Gas, Water, Steam, and Hydraulic Fittings, including Pipe Lines, Welded Steel Fittings for Oil, Water, and Hydraulic. Previous experience in this class of business essential. State age, salary required, giving full details of previous employment.—Address, P5402, The Engineer Office. P5402 A

WORKS MANAGER for Engineering Shop; Must be conversant with modern methods in general engineering, including organisation and costs; accustomed to control of men.—Apply by letter, stating full experience and salary required, SIR WILLIAM ARROL and CO., Ltd., 85, Preston-street, Glasgow. 8235 A

WORKS MANAGER REQUIRED in Midlands for important Bridge, Constructional, and General Engineering Works; thoroughly capable all-round man with previous experience and full knowledge labour prices.—Address, P5429, The Engineer Office. P5429 A

WANTED by a Firm of Chartered Patent Agents, an occasional DRAUGHTSMAN, who must be used to making Patent Office Drawings quickly from sketches, models, &c. State age, experience, and charge per day. Hours 10 to 5, one hour for lunch.—Write, Box 994, Reynell's, 44, Chancery-lane, W.C. 2. 8253 A

WANTED, JUNIOR DRAUGHTSMAN; Some knowledge of Centrifugal Pumps an advantage.—Address, stating full particulars and salary required, 8209, The Engineer Office. 8209 A

WANTED, DRAUGHTSMAN, Accustomed to Centrifugal Pumping Machinery.—Address, stating full particulars and salary required, 8210, The Engineer Office. 8210 A

WANTED in Railway Engineer's Office, London, ONE or TWO First-class CIVIL ENGINEERING DRAUGHTSMEN and DESIGNERS.—Address, 8185, The Engineer Office. 8185 A

SITUATIONS OPEN (continued)

CAPABLE Constructional Steel Work Designing DRAUGHTSMAN REQUIRED IMMEDIATELY; knowledge of Building Construction an advantage. State age, experience, and salary required.—Address, 8183, The Engineer Office. 8183 A

CONSTRUCTIONAL ENGINEER'S DRAUGHTSMAN WANTED in London. Only designers having experience in Steel Frame Building need apply.—Address, 8195, The Engineer Office. 8195 A

DRAUGHTSMAN REQUIRED, North-East Coast. Must be thoroughly competent on all classes of Structural Work and Bridge Work; age 30 to 40. Full particulars, stating salary required.—Address, 8239, The Engineer Office. 8239 A

STRUCTURAL STEEL WORK. — JUNIOR DRAUGHTSMAN REQUIRED for London office, able to take off quantities from drawings and detail all classes of steel work.—Address, giving full particulars and salary required, P5430, The Engineer Office. P5430 A

BOILERMAKER FOREMAN.—WANTED, a Thoroughly reliable MAN, to Take Charge; able to estimate, used to piecework and semi-skilled labour; only one who has held a similar position need apply. State full particulars as to experience, wages, &c.—Address, P5435, The Engineer Office. P5435 A

SITUATIONS WANTED

WANTED, a POSITION as PUPIL (Small Premium) to Civil Engineer, by a Young Engineer, Stud. I.C.E.; 6 years' apprenticeship with Messrs. Vickers, general workshop and office experience, trained in technical subjects.—Address, P5427, The Engineer Office. P5427 B

A YOUNG MECHANICAL ENGINEER DESIRES START. Energetic, well-educated, ex-officer, B.Sc., practical works experience. Will start in any capacity where good opening offered.—Address, P5433, The Engineer Office. P5433 B

BUYER.—The MANAGER of a Large Engineering Works Purchasing Dept., who has an exceptionally wide knowledge of the markets of the country, DESIRES to NEGOTIATE NEW APPOINTMENT.—Write, Z. M. 613, c/o Deacon's, Leadenhall-st., E.C. 8220 B

ENGINEER, Certified, Well Experienced with steam, electrical, hydraulic, refrigerating, gas, oil machinery, and boilers, workshops, steady man, WILLING to TAKE any JOB. Moderate salary if permanent employment. Excellent references.—Address, P5403, The Engineer Office. P5403 B

SINGAPORE.
ENGINEER, Practical, Technical and Commercial experience, A.M.I. Mech. E., M.I. and S.I., going to Singapore, would be GLAD to HEAR of PERMANENCY, S.S. or China. Eight years' experience S.S., for some years works manager to largest firm in Fed. Malay States. Thorough experience, erection and maintenance steam, gas, Diesel engines, boilers, rubber, mining, oil mill machinery. Expert designer, sales experience. Speaks fluent Malay and little Chinese. Age 34. Moderate salary with prospects, any capacity.—Address, P5410, The Engineer Office. P5410 B

ENGINEER or WORKS MANAGER, 16 Years' Experience, first-class references, used to chemical works, specialising in erection and management of distillation plants; OPEN for ENGAGEMENT, home or abroad.—Address, P5401, The Engineer Office. P5401 B

ENGINEER, Recently Returned from Abroad, SEEKS SITUATION. Thorough knowledge of marine and mechanical engineering and up-to-date workshop practice; university education. Accept moderate salary. Knowledge of Russian and Chinese languages. Any position acceptable. Excellent references. Age 30.—Address, P5408, The Engineer Office. P5408 B

ENGINEER (32), Shops, D.O., Technical, Commercial, internal combustion, printing, rubber, and general engineering; good education, adaptable, inventive, energetic, enthusiastic, diplomatic; £350.—Address, P5331, The Engineer Office. P5331 B

ENGINEER (32), 1st Class B. of T., 17 Years' Exp. general engineering, internal combustion and refrigerating machinery, SEEKS POSITION anywhere in U.K.; thoroughly practical man.—Address, P5428, The Engineer Office. P5428 B

ENGINEER, Thoroughly Practical, Combined with theory in steam, oil, gas, mining machinery, office routine, draughtsmanship, &c., late engineer to well-known companies, excellent testimonials, DESIRES APPOINTMENT abroad or home.—Address, P5340, The Engineer Office. P5340 B

ENGINEER, 10 Years' Australian Experience, shortly arriving England, thoroughly conversant Colonial conditions, in touch with machinery and hardware houses and buyers, would REMAIN in ENGLAND if sufficient inducement offered.—Address, P5404, The Engineer Office. P5404 B

ENGINEER (24), Mech., 9 Yrs. Experience, 5 Yrs. apprenticeship well-known firm, 2 yrs. technical, DESIRES POSITION as Assistant.—Address, P5424, The Engineer Office. P5424 B

ENGINEER, 39 Years of Age, at Present General supt. of Ironworks in America, trained in England, 12 years in Canada and America, large experience in iron and steel works, coke oven and by-product plant, blast-furnaces, steel furnaces, rolling mills, pipe manufacture, constructional engineering and ferro-concrete work, is DESIROUS of APPOINTMENT in Great Britain owing to family reasons.—Address, 8237, The Engineer Office. 8237 B

ENGINEER OFFICER, Just Demobilised, SEEKS APPOINTMENT in which knowledge of shipbuilding, mechanical, motor engineering, transport, and sales might be utilised. Possesses tact, organising ability, and initiative. Knowledge of French and German.
Last two years control officer in German engineering works. Excellent references from large engineering works pre-war, also Army.
Prepared to go to any part of the world. Age 31.
Address, P5426, The Engineer Office. P5426 B

ENGINEER'S IMPROVER (22), Well Educated, 5½ years' apprenticeship, good knowledge machine drawing, experience of steam, electric and motor cars, SEEKS JUNIOR DRAUGHTSMAN'S POSITION or similar work with view to advancement. Student evening tech. institutes.—Write to "IMPROVER," c/o Abbott's, East cheap, London, E.C. 3. P5407 B

FERRO-CONCRETE.—SPECIALIST ENGINEER, with wide and varied experience in handling design and construction (bridges, buildings, docks, harbour works, &c.), is OPEN for APPOINTMENT, England or abroad.—Address, P5412, The Engineer Office. P5412 B

GENTLEMAN, with Full Business and Engineering qualifications and experience, DESIRES to REPRESENT in (or TAKE CHARGE of) LONDON OFFICE for Manufacturing Firm, where industry and concentration, coupled with a detailed knowledge of all aspects of buying, costing, manufacture, sales, and publicity, will bring results mutually satisfactory.—Address, P5307, The Engineer Office. P5307 B

MECHANICAL ENGINEER, Late Manager of Small works, NEEDS POST where 30 years' general experience, organising ability, tact and initiative is of value.—SNOAD, 86, York-road, Hitchin. P5436 B

SITUATIONS WANTED (continued)

DRAUGHTSMAN (Mechanical) SEEKS SITUATION; general engineering; 6 years' shop and drawing office experience. References, indentures.—WALLEE, 58, Siddons-road, Forest Hill. P5431 B

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For continuation of Small Advertisements see page iii

Iron and Steel Institute.

No. II.*

AT the opening of the second day's proceedings the award of the Carnegie Research Scholarships for 1922 was announced as follows :—

To Mr. Arthur Bramley, of Loughborough College, a grant of £100 to assist him in studying the carburising and decarburising effect of different gases on iron and steel, and the catalytic influence of various substances.

A grant of £100 to Mr. A. L. Curtis, to carry out an investigation of steel moulding sands and their behaviour under high temperatures.

A similar grant to Mr. Owen W. Ellis, who is Lecturer in Metallography at the University of Toronto, for the purpose of studying the effect of constitution on the malleability of iron, steel and alloys thereof at high temperatures.

A further sum of £100 to Dr. J. Newton Friend, Lecturer at the Birmingham Technical School, for his investigations on the corrosion of iron and steel, in which he has now specialised for many years, to enable him to continue his tests on a larger scale.

A grant of £100 to Mr. Arthur M. Parkin, for the purpose of studying the influence of heat treatment and of variable carbon content upon a magnet steel (tungsten) with a constant tungsten composition.

A grant of £100 to Mr. Gusta Phragmen, who has worked in the Stockholm High School Physical Laboratory, under the direction of Dr. Carl Benedicks and is now engaged in the Metallographic Institute at Stockholm, where he has done excellent work on the radiography of metals. He proposes to study the specific weight of molten metals by a new method which permits of independence of the volume changes of the solid bodies used and of capillary action.

A grant of £100 to Mr. William Ellis Williams, who has worked out a new method of X-ray spectrographic analysis of metals and proposes to apply the grant to the study of the application of X-ray spectrography to the examination of the structure of steel.

A discussion then followed on the paper by Mr. D. E. Roberts, "Notes on Blast-furnace Filling," an abstract of which appears below.

NOTES ON BLAST-FURNACE FILLING.

The mechanical charging of blast-furnaces has developed along two principal lines, the skip and the bucket, and beyond a very brief reference to a few of the best-known examples of each, this paper will be devoted to a general comparison of the two main types.

Without going historically into the question of the developments to date, it may reasonably be accepted, as a basis of discussion, that distribution due to properly controlled hand filling is ideal. The early attempts at replacement were all, with one exception, on skip lines. It was soon found that, owing to the separating or shovel effect of the skip, serious errors in distribution took place. Methods to remedy these errors were the incorporation of various kinds of revolving tops, all of which doubtless in a measure led to improved conditions, and some of which are to-day giving fairly satisfactory results. It must not be overlooked, however, that such devices are but means of rectifying a method of charging that is fundamentally inaccurate and further, that such additional equipment is not altogether desirable on the top of a furnace, is troublesome to keep in order, and will do much more harm than good should it get out of commission unnoticed for a little time.

The objections to the bucket arrangement that have been advanced are :—

(1) Its first cost. The adoption of the ordinary skip incline to bucket carrying does undoubtedly mean increased weight of structural material, especially if complete stiffness is to be ensured. It is a matter for consideration whether the incline is really the best device for handling the large type of bucket that seems to be coming to the front to-day.

(2) The unit charge is said to be too large. It is undoubtedly true that when the bulk of the burden is very fine, as with some American conditions, split charges, that is, thin layers, are sometimes necessary.

(3) It has been asked, How can a furnace that drives faster on one side than another be filled properly with a bucket? No serious difficulty has been experienced from this cause that cannot in practice be overcome by adjustment at the tuyeres.

The best means of carrying the bucket to the top of the furnace is a matter well worth discussion. The incline is eminently suitable to the skip. When, however the heavier loads to be treated by the bucket are considered, as well as the extra length of stem, the difficulties of swinging and general stiffness of structure required—the rectangular or "vertical-horizontal" method is worth consideration. This method has likewise the distinct advantage of being able to pick up from several points, and the structure is, in addition, of great assistance in facilitating the removal of the bell and any heavy repairs that may be required at the top.

In balancing up the relative disadvantages of the two systems it must not be overlooked that the skip, especially in its most modern double form, is likely to lose some of its disadvantages if the present tendency of ore dressing and sizing becomes universal. The skip is also the cheapest arrangement as far as outlay is concerned, because, broadly speaking, it deals with small quantities often as against the bucket, which deals with large quantities at less frequent intervals. The former requires a somewhat lighter structure than the other; but as, at the same time, there is more frequent movement, there is consequently more wear and tear.

The bucket system provides a furnace top which is practically as simple as that of a hand-filled furnace, and also affords an easy means of removing the bell and doing heavy repairs, which is an important matter. Every iron and steel works man knows that one of the worst possible places to put any complicated and delicate machinery is on the top of a blast-furnace. It has been said that the dressing of materials will help distribution; but, in my opinion, it is insufficient to select a filling apparatus which will only do the work under the most favourable circumstances, as with dressed materials. The method chosen should be capable of giving ideal distribution under any circumstances, and with any class of material.

Nothing has a more important bearing on the satisfactory operation of the furnace, the wear and tear of the lining, and its life generally than proper charge distribution. The shovelling effect of the skip is not imaginary; it is a real defect. That was for some considerable time one of the causes of trouble, even with the bucket arrangement.

It was found upon investigation that the material running down a shoot out of a bunker had the same separating effect; that is, that the lumpy material was thrown to the far side of the bucket and fine material immediately beneath the shoot. Drum outlets have been applied to overcome this difficulty, but the usual method to-day is to spin the bucket while it is being filled. This is a simple illustration of the much more marked positive separation that is brought about by a skip at the furnace top.

The bucket arrangement has another distinct feature with regard to coke, which can be handled without bunkering if desired. This is, in many districts, an advantage as reducing breakage. It is quite common now for the coke to be loaded at the coke ovens into the furnace buckets direct.

The paper is accompanied by a large number of drawings on folding plates.

Mr. A. K. Reese, who dealt with the subject from the operating standpoint, said that it was clear that the skip type of hoist was less costly to instal, and in its latest form was not inferior to the bucket system in obtaining good distribution of the material. The revolving furnace top was a complication to which many engineers would object. The question of flexibility of the plant installed was important, and whereas in the bucket hoist large loads were as a general practice carried slowly, the skip hoist was designed to carry small loads swiftly. It was only by actual experience at the blast-furnace that the most suitable size of charge for any furnace could be determined, and a definite coke unit should not be fixed in advance. On the other hand, it was necessary to have the power to vary the size of the unit, and in the bucket hoist the capacity for variation could only be obtained by decreasing the efficiency of the plant. His main objection to the bucket system was that it was too rigid, and that only the skip hoist gave the necessary flexibility. It had been suggested that wear and tear was excessive with that type, but it would be a reproach to the engineer in charge if that were the case. His conclusion was that from the practical point of view the skip hoist was to be preferred.

Mr. A. Lennox Leith, referring to the arrangement shown on Fig. 17 of the paper, criticised it as most unsatisfactory owing to the amount of dust. A dust collecting arrangement was essential with a plant of that description. It was an advantage when the coke ovens were in close proximity to the furnaces to fill the buckets direct from the ovens and thus save any second handling of the material. It ought to be possible to arrange a bucket system to feed two furnaces, and it was very doubtful whether such an arrangement would be more costly than two skip hoists.

Mr. F. Clements was entirely opposed to the bucket hoist. It was generally agreed, he said, that if good results were to be obtained with this hoist it must be of the revolving type, and the man in charge had it in his power to make or mar the distribution in the furnace. The relative cost of the two systems had been referred to and might be the dominating factor. There were only two skip gears worth consideration, the McKee and that with which his own name was associated. The first-named had been developed to suit American conditions, and to deal with ores of a uniform character. There was no need for revolving the gear, and at South Chicago the distribution obtained by the use of that gear with Lake ores was quite satisfactory. In Great Britain, where the ores were of a very mixed character, that arrangement would not work, and an apparatus capable of giving good distribution must be employed. That was secured by the gear which had been installed at Park Gate, where the distribution was fully equal to, if not superior to, that secured by hand filling. The balance of evidence was on the side of the skip gear.

Mr. J. H. Harrison said that in using mechanical appliances for blast-furnace plant care must be taken that the result achieved was as good as the manual labour. The system which gave the best distribution of materials inside the furnace was the one to be adopted. It was a defect of the skip system that it broke the coke to a far greater extent than the bucket system, and was far less suitable for charging the furnace on that account. The coke should be screened before it was delivered to the furnace, and the fines used for other purposes. He also advocated taking the small out of the ore. The mechanical charging of blast-furnaces was a very big question and required careful consideration of the many points involved before reaching a decision.

Mr. Roberts, in replying to the discussion, said that the case for the skip arrangement had scarcely been established. In America, which was the home of the skip, the whole thing had been worked out in such detail that the marvel was that the bucket plant ever obtained any footing at all. Its merits were now, however, beginning to be recognised, and it had been installed in between thirty and forty plants in the United States. He knew of bucket plants that had been in operation for over four years, averaging 550 tons a day, which had worked satisfactorily over that period. He had been told by the President of the Carnegie Corporation that no other arrangement but the bucket would ever in future be installed at the blast-furnaces of that company. To the various other points which had been raised he would reply in detail by correspondence.

A paper on "Recent Developments in Power Production" was read in abstract by Colonel D. Selby-Bigge. The title of the paper gives a clue to its contents, but it may be noted that the discussion of water-power is purposely omitted.

Mr. H. M. Ridge agreed that the question of cheap power supply was of paramount importance. Two years ago something like 70,000,000 tons of material were being treated by flotation, and the figures given by the author for the recovery of coal did not really illustrate the case. His figures were indeed subject to correction in several respects. As to further sources of power supply in this country, he had investigated the possibility of utilising the CO_2 content of limestone which at present went to waste, and he hoped that success might be achieved in that direction.

Mr. W. H. Patchell said, that out of the immense amount of material in the paper there were one or two points which he would like to emphasise. It was the boiler-room that was the Cinderella of the whole business, and our most urgent need in Great Britain was for efficient supervision of the plant. The economies open to those engaged in the iron and steel trades were well worth striving for. The super power station of which so much has been heard during the past few years was not now regarded with unqualified favour, and it was known that some of the lowest consumptions recorded by the author and others were obtained by small stations. One figure which was contained in a recent report on the subject, quoted the figure of 1.7 lb. per kilowatt-hour, a figure which was recorded by a small gas producer plant. Reference was made by the author to steaming capacities of boilers, which had been exceeded many years ago, and he had had super-heaters working for nearly as long a period at the temperatures mentioned by the author as a recent achievement. He had obtained good results with waste heat boilers in association with gas engines. He challenged the statement that the Ford boilers mentioned in the paper were the largest that had ever been installed. Boilers with 29,820 square feet of heating surface were now in operation in America. Power production at cheap rates was absolutely essential for the needs of industry, and nothing had done more to assist cheap power production than the publication of figures. He hoped there would be no hesitation on the part of those possessing power plants to publish their results. The Electricity Commissioners had a great chance of assisting the publication of figures and of paving the way for a greater advance in this field.

The next paper taken was that by Messrs. A. Westgren and G. Phragmen on "X-ray Studies on the Crystal Structure of Steel."

Sir William Bragg said that the subject discussed in the paper had an intimate relation to the strength of metals. One question raised to which he would like to refer was the character of the distribution of the carbon in carbon steel. It would be interesting to know whether the distribution was regular; if the carbon atoms were simply placed here and there or were more or less at an average distance from one another. From the scientific point of view the authors had done a fine piece of scientific work, but it also had a practical value. What had been done was in a sense the direct outcome of the effort made by Sweden during the war period to push forward the study of metals by X-ray methods. A special institute had been started for the purpose, and he hoped that something would be done to initiate work of the same kind in Great Britain, through the Department of Scientific and Industrial Research. Dr. Scherrer had been working during the past year and had finally evolved an apparatus which could be set up without any great difficulty and applied by technical workers. Much depended in connection with the materials used by engineers on the relation between the atomic forces, and to ascertain those forces it was necessary to find the crystal structure. It was of enormous importance, therefore, to push on with work of the kind described in the paper, and although it might take a long time for scientific results to become of economic value, that would be the ultimate result in many cases. He was so impressed with the magnitude of the work that he had not the least hesitation in asking that an effort should be made to find a sum of £50,000 to establish an institute to carry out investigations on X-ray studies of the structure of metals. The Iron and Steel Institute would be serving the needs of the industry it represented if it could arrange to provide for the services of one man to take up the subject from the point of view of the iron and steel trades. There was much to be done in this field of research, and the work ought not to be left to other countries.

Dr. W. Rosenhain expressed his appreciation of the work which had been accomplished in this field. It was interesting, but not surprising, to find that the space lattice of delta iron was similar to that of alpha iron. With regard to the influence of carbon and its distribution in gamma iron he was not quite sure that the author had exhausted the subject. It was suggested that the carbon atoms were not incorporated as part of the gamma iron space lattice work but were pushed in between. That seemed quite improbable. Sir William Bragg had suggested the desirability of ascertaining whether there was any regularity in the distribution of carbon atoms in gamma iron, but he, Dr. Rosenhain, suggested that that could only be the case after prolonged annealing. They all hoped that Dr. Westgren would pursue the valuable work on which he had been engaged for some time past, and that investigations of the same kind would be undertaken in Great Britain.

Professor H. C. H. Carpenter thought that the evidence produced by the author in support of his

* No. I. appeared May 12th.

conclusions was very convincing, and he would like to point out that what had been done in Sweden fitted in quite well with the results of work in another direction which had been carried out by Professor Honda. The latter had said it was very probable that delta iron had the same structure as alpha iron. It had been very difficult to get evidence of the structure of that form of iron which was so near the melting point of the material. The first evidence on the subject was obtained in this country by Dr. Ball, whose use of the thermal method at that time was a great achievement.

Colonel Belaiew also commented on the interesting fact that delta and alpha iron had the same structure. That was the fundamental structure of iron, and that of gamma iron, which was much more complex, was not typical of the material. It would appear that cementite did not crystallise in the regular system, but he would suggest that that branch of the subject could be further investigated.

Mr. D. Hanson added one or two words on the subject of delta iron. He had, he said, been studying a number of iron alloys at the National Physical Laboratory, and had obtained microscopic evidence that there was a structural re-arrangement at the delta iron point. It was extremely well marked in the case of the iron carbon alloys.

Dr. Westgren, who was very warmly received on rising to make a brief reply to the discussion, thanked Sir William Bragg and the others who had shown such interest in connection with his work. Time did not permit him to deal with the whole of the discussion, but he would reply to the questions which had been raised by correspondence.

The last three papers taken were one by Colonel Belaiew on the "Inner Structure of the Pearlite Grain," one by Mr. J. H. Whiteley on the "Formation of Globular Pearlite" and one by Mr. Hallimond on "Delayed Crystallisation in the Carbon Steels."

Some Small Jigs.

We have already referred, in connection with the British Industries Fair, to the small tools manufactured by C. A. Vandervell and Co., Limited, of Brighton, as illustrating an excellent effort on the part of a British firm to compete in a trade which hitherto has been practically monopolised by American makers, and we were rather astonished to find, during a casual visit to the factory, that practically all the work of production on these highly finished tools is carried out by mere boys who have just left school. This fact is even more remarkable when the environment of the workers is taken into consideration, as the works are situated at the Portslade end of Brighton—a place where it would not be anticipated that the younger inhabitants would possess, or inherit, any great mechanical aptitude.

As a matter of fact, the employees engaged on actual production in these works need only the smallest degree of manual skill, and the devices which have been evolved by Messrs. Vandervell's engineers to permit such conditions of work so interested us that we accepted an invitation to pay another visit to the works with the idea of putting before our readers descriptions of some of the operations carried out there. It should be pointed out, however, that the following notes make no attempt to give a connected account of all the processes through which the tools pass in the course of manufacture, as not only would such an account occupy too much space in this journal, but it would also involve a lengthened stay in the works to follow through all their stages of development a score or so of tools, made each in a variety of sizes. It is thus our intention rather to give a few sketches which show how ingenuity and a generous initial expenditure can reduce the cost of production on even such small items as calipers, dividers, V blocks and so forth.

The Tool Shop.

The above remarks must not, of course, be taken to suggest that little or no skilled labour is employed at the Vandervell Brighton works, and, as a matter of fact, the factory is divided up into two equal-sized bays, one of which is manned by highly skilled mechanics, while the other is occupied by the youthful operators, who, naturally, are supervised by a few skilled men. The first-mentioned bay is equipped with a fine collection of accurate machine tools, and its business is to provide the jigs and apparatus utilised in the production department. In view of the fact that the company is continually extending the range of its products, this work alone gives employment to a number of men. The department also, however, does a similar class of work for the same company's Acton factory, while a certain amount of outside work is carried out. It has been found that it requires on the average about three months to perfect the scheme for manufacturing any new tool, and as the output is being extended by the addition of two new items every quarter, it will be seen that there is quite a large amount of tool-room work to be done for the Brighton factory alone.

While writing in these general terms, it is worthy of note that all the small jigs are made throughout of tool steel, and are tempered throughout, as it has been found that no other material will stand up to the habit the lads have of knocking the jigs on the machine bases to clear them of swarf.

The Brighton factory was originally erected by Messrs. Vandervell for the production of magnetos for war purposes, and was thus equipped with a representative assortment of machine tools. With the exception of a few new machines, these tools have all been adapted to the new requirements. In the tool shop, or jig-making department, the change has only necessitated minor alterations, but on the production side some of the tools are hardly recognisable. Thus a horizontal milling machine has been converted into a polisher for flat surfaces. The work table remains the same, and is operated by hand feeds, but in the place of the original cutter spindle there is a pair of rollers, mounted in a frame, round which a band of emery cloth runs. The frame is supported by swinging links so that it can be lowered on to the work or set at an angle.

Polishing.

Polishing plays an important part in the production of many of the tools, as a handsome appearance is insisted on by the inspecting department, and a number of special devices have been rigged up for facilitating this class of work. Flat caliper legs, which have been stamped out of sheet steel in a press, are polished on both sides on Linishers—little machines in which a band of emery cloth stretched between two rollers travels across the top of a flat table. Whilst they are being polished the caliper legs are held on to the lower face of a fairly heavy iron plate by an old magneto magnet. The magnet poles are flush with the under surface of the plate, from which they are separated by non-magnetic metal, but as they are only required to hold the work pieces up against slightly projecting pegs, which prevent the calipers from moving along under the drag of grinding, the loss of magnetic flux through the iron plate is not important. The arrangement has the advantages that the weight of the plate regulates the rate of polishing and its mass absorbs the heat generated, so that the tool is not discoloured, while it obviates the boys taking the skin off the ends of their fingers. The amount of material removed from the stock in this process ranges from one to two one-thousandths of an inch. For polishing the edges of the caliper legs rotary hobs covered with emery cloth are used. The hobs have grooves cut round their peripheries to give a slight radius to the edge of the work, and the emery cloth is held in place by its edges being tucked into a longitudinal groove in the hob and held there by an iron wedge.

On some of the tools the polishing has to be carried into comparatively sharp corners without the general trend of the polishing marks being altered, and for such purposes an expedient which, at first sight, appears to be a rather bold one has been resorted to. We noticed that it serves the purpose quite satisfactorily. A polishing wheel or hob of sufficiently small diameter to get into the corner was found to be altogether impracticable, so some gear was rigged up to do the job as indicated in the sketch Fig. 1. On a framework of bars there are arranged two shrouded pulleys, one of which is driven from the line shaft. Above them, and in the same plane, there is fixed a block of gun-metal that is brought to a fairly sharp corner corresponding to the radius which has to be polished. A band of emery cloth is stretched round the two pulleys and the block, and is driven at a high rate of speed. The work is pressed on the band at the corner and a very nice finish is produced. It might be expected that the fixed block would get so hot through friction that the band would be destroyed, or, at least, the glue holding the emery would be softened; but although the block does get decidedly warm, the band comes to no harm, and its polishing side is worn out before the backing gives way.

Another ingenious adaptation for polishing purposes is used on the bevelled edges of screws. The screw is chucked in the spindle of the remnants of a small high-speed milling machine. Fixed on a bar, projecting to the rear at an angle of 45 deg., there is placed the tailstock from a small lathe. On the front end of the tailstock spindle a little emery wheel, driven from the overhead shafting by a gut band, is fixed. The spindle is provided with a lever feed, with which the wheel is brought up to the work, and a boy can put a nice finish on the screws with this device at an astonishing speed. There are many other equally simple, yet effective, contrivances used for polishing purposes, but enough has, perhaps, been said concerning this branch of the work.

Making Caliper Legs.

Three distinct patterns of calipers are made, and each has the curved form given to its legs in a different manner. In the case of the ordinary firm-joint type the legs are blanked out to the final shape, from sheet metal, in a press. For the spring calipers with rectangular legs, a pressing operation is also employed, after they have been milled to shape in straight lengths. The legs are put, one at a time, into a pair of bending tools, in a long stroke press. It will be appreciated that some care had to be exercised to design these tools so that the legs should not turn over on their sides during bending, and so that the straight part should not draw down towards the curve as the bend is made. The tools are subjected to a very hard nip at the end of the stroke to give a permanent set to the material—it is hard steel—and to prevent it springing back when the dies are opened. This bending operation is one of the few which are carried out at Acton, instead of Brighton, as the seaside works are not yet equipped with a press of long enough stroke. The tool makers' calipers have their round legs bent in the tools illustrated by Fig. 2. The legs are first tapered in a swaging machine, which leaves a good bold shoulder at the end of the parallel part. This shoulder is used to locate the leg in the bending tools. The leg is slipped into a groove in the part A and is held in place by the handle being slid over it. The handle has a bayonet slot, engaging with a pin on A, that pulls the shoulder of the leg up against a projection in the groove and holds the work firmly. The handle is swung back, about the pivot B, until it meets the stop C, and the reverse curve is thus made against the former D. The bow is shaped around the former E by the little roller F on the other handle. The curvature of this former has a gradually decreasing radius, to make allowance for the spring of the leg when it is released, while the taper of the leg adds to the departure from a circular track required of the roller F. The handle thus has an elongated hole at its pivot end and a projection on the under side which engages with the cam plate G. This plate is so formed that it pushes the handle inwards, and with it the roller F towards the end of the movement and thus finishes the bend.

The jig shown in Fig. 3 is used for another operation on the tool makers' calipers. The holes in the shanks of the legs for the adjusting screws have to be enlarged in one direction to accommodate the angular movement. The hole in one of the legs is blind, but the one in its mate passes right through. The legs are put in the jig and positioned by the pin A engaging with the recess for the pivot, while the excentric B clamps it in place. A plain drill running in the bush C is first used to make a round hole, and in the case of the blind hole a stop is used to fix the depth. The jig is then moved to the next spindle of a multiple spindle drilling machine, which is equipped with a little end milling cutter. The lever D is depressed slightly, which has the effect of rocking the jig about the pivot E. A cut is then taken to the full depth, and the process repeated, with the angle increased, until the two faces F F meet and thus determine the extent of the elongation. It will be noticed that the centre of the pivot E is immediately at the back of the leg, with the result that the hole is not elongated on that side. It usually takes five or six passes to finish a hole.

Milling Caliper Legs.

Milling plays an important part in the shaping of the caliper legs, and some of the patterns go through quite a large number of operations of this class. For these purposes the legs are bunched together in half dozens and very rigid jigs are used to hold them and withstand the drag of the forming cutters, as the area of the gripping surface is small compared with the amount of stock which has to be removed. Figs. 4 and 5 show the jigs and cutters for forming the two sides of inside caliper legs. It will be noticed that the blanks are held down in the jigs by bridge pieces, and that large gaps are left in the milling cutters to accommodate these bridges. The part of the blanks obscured by the bridges is cleaned up in a subsequent operation. The cutters are built up of several separate sections, so that they can be altered to suit different sizes of calipers. By such means as these it is assured that all articles of any class are exactly alike, so that assembly is greatly facilitated, while replace parts can be supplied from stock. To such an extent is this principle carried that even the grinding of the points on the legs is done to gauge. This operation is carried out on a face grinder of which the table has a semi-circular stud set in the extreme edge, so that its virtual centre lies in the plane of the grinding wheel. The caliper leg is fixed on a plate which has a notch in the edge to engage with the stud just mentioned. By swinging the plate round on the table the end of the leg is ground to a true curve and only a definite amount of material can be removed from the stock.

A handy little device is used in drilling and tapping the adjusting nuts for the spring calipers, and is shown in Fig. 6. The nuts are made in a capstan machine, but have to be drilled afterwards. They are centred under a high-speed drill by the two clamping levers shown, which have half bushes of brass let into their sides to hold the nut. It will be noticed that the pivots of the levers are a short distance apart. They are fixed in the table of the drilling machine, and the levers will consequently only close on the nut when it is in the proper position. The positioning is quite definite, and is very quickly effected.

Vee Blocks.

Among the various products of the works, V blocks take an important place, and are made in three different types, cast iron, case-hardened mild steel, and hardened and ground tool steel. Each of them is manufactured in quite a distinct manner. The V grooves are milled in the cast iron blocks while they are fixed in rows in the vice of a horizontal milling machine. They are then transferred to the big rotary jig shown in Fig. 7, which is mounted on the table of a vertical mill. The first operation is to mill the ends of the blocks while they are held in the position shown at A, when they are pinched back against the stops B by the clamps C. The blocks can easily be

JIGS AND DEVICES FOR MAKING SMALL TOOLS

C. A. VANDERVELL AND CO., LIMITED, BRIGHTON, ENGINEERS

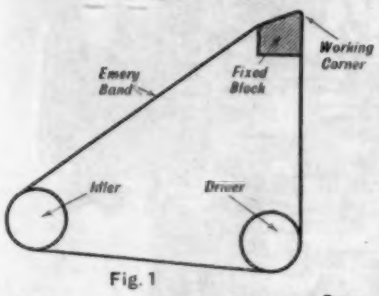


Fig. 1

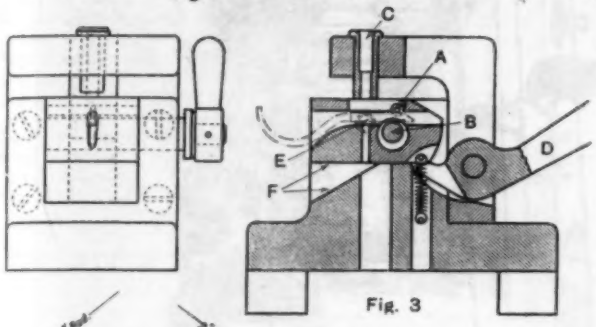


Fig. 3

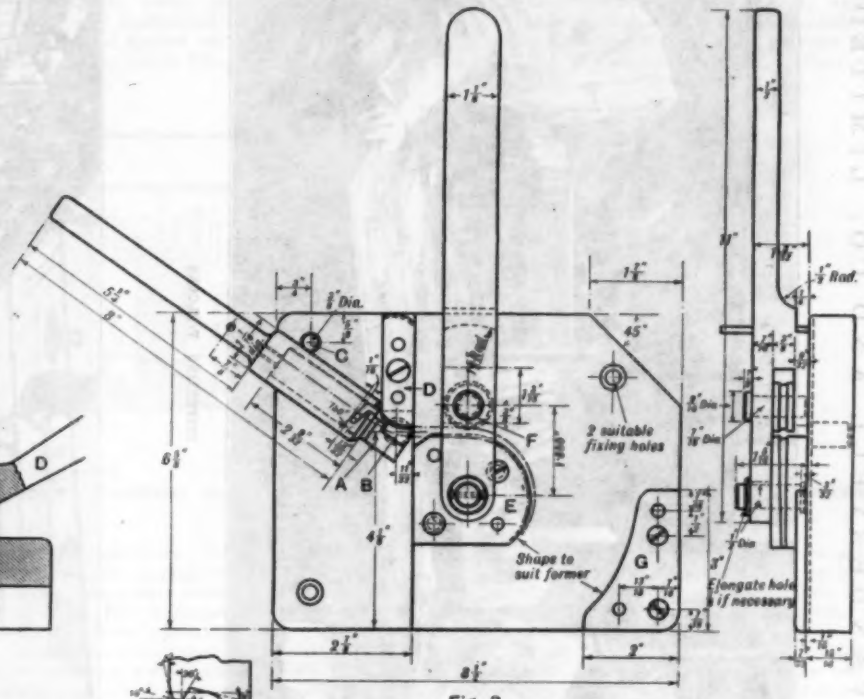
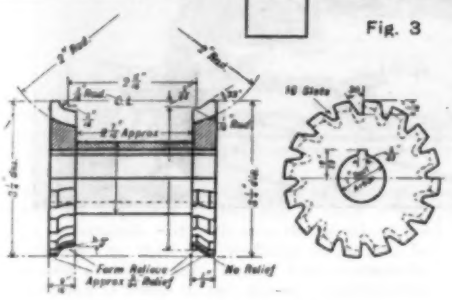


Fig. 2



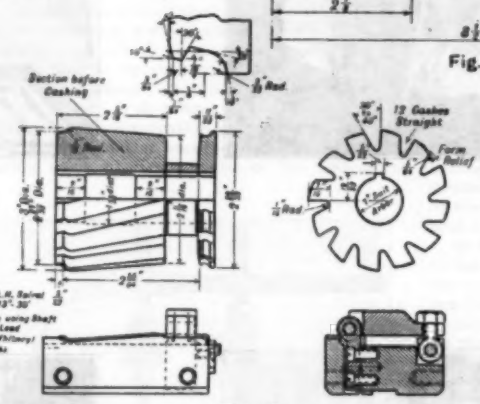


Fig. 5

Fig. 6

Fig. 4

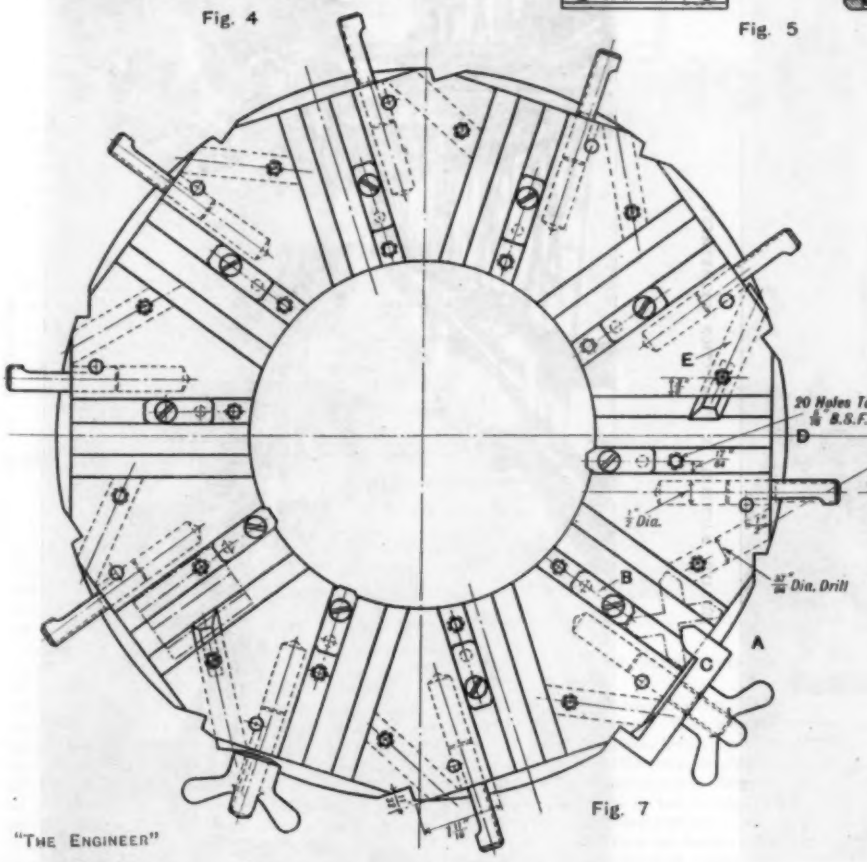


Fig. 7

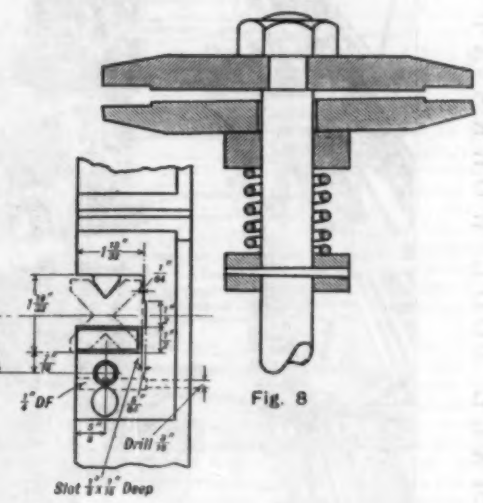
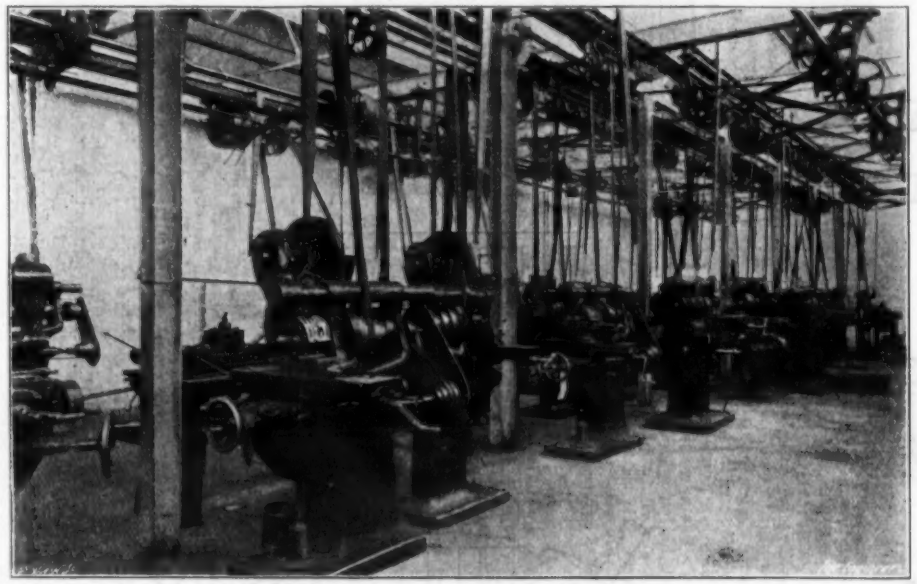


Fig. 8

"THE ENGINEER" SWAIN Sc.

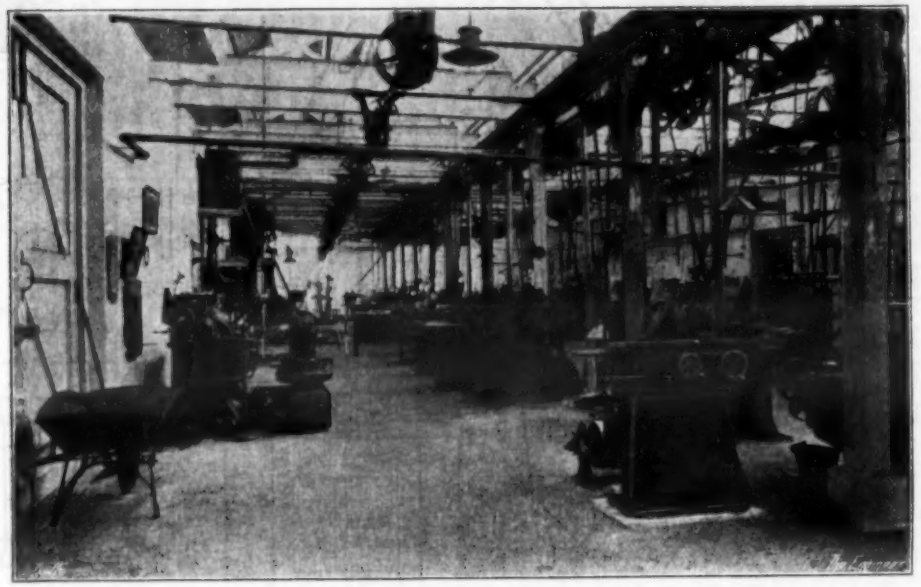
THE SMALL TOOL WORKS AT BRIGHTON OF C. A. VANDERVELL AND CO, LIMITED



MILLING MACHINES IN PRODUCTION DEPARTMENT

INSPECTING V-BLOCKS

TOOL AND JIG DEPARTMENT



TOOL AND JIG DEPARTMENT

put in place by a lad, as the jig rotates, and taken out after having passed under the milling cutter. The stops B are then reversed, as shown at D, the blocks are laid on their sides, and are held by the diagonal plungers E while their faces are milled. The case-hardened V blocks are milled out from short lengths of a special cruciform bar and are then parted off by a gang of slitting saws.

The hardened and ground V blocks are finished to a much higher degree of accuracy than is the case with the other two types, and a historical record is kept of each pair made. The bars of tool steel are sawn up into lengths of 7¼in., sufficient to make four blocks, and are then milled all over, leaving sufficient allowance for grinding. The blocks are then cut off and sent to the hardening department, where they are heated to a temperature of 820 deg. Cent. and given ten changes between an oil bath at about 180 deg. Cent. and cold water. This treatment has, of course, the effect of seasoning the metal and at the same time of tempering it. The blocks are tested for hardness and sent to the grinding department, where they are rough ground to within 0.004in. of the finished sizes. They are then returned to the stores, where they are kept for thirteen weeks before the finishing grinding is done. Even after this the blocks are kept in the inspection department for a week, during which they are checked daily, before they are issued for sale.

VARIOUS PRODUCTS.

A good example of the extent to which expenditure has been incurred at these works with the object of reducing production costs is given by a little tool maker's bevel gauge. The stock, which is 3in. long, is made of three pieces of steel plate riveted together. The L-shaped blade is a single stamping of hard steel. The slot in the blade which takes the clamping bolt is also L-shaped, and is made at one operation by punching. It is obvious that it would be a costly business, comparatively speaking, to clean out this narrow slot if it were not punched accurately, and so very great pains were taken to make the dies produce a slot of the required degree of accuracy. We were informed that the tools for this one operation alone cost some £80, but the expenditure appears to be justified, for no perceptible burr is made on the lower side of the blade, and the edges of the slot have an almost burnished finish.

Two of the most recent additions to the output of the works are a pocket scriber and a little screw-driver to correspond. In each case the shank of the tool is hollow, so that the working point can be reversed and stowed inside, and it was noteworthy that the shank is made in two pieces to permit the bore being drilled right through. The head which closes the end of the hole is fixed on a plain spigot by shrinking, and although the diameter at this point is only about ¼in., and the material is very thin, the heads are quite secure. A simple, yet very useful, little device, shown in Fig. 8, was being used for cutting the flats on the end of the screw-driver, and is employed in a number of similar operations. The flats are actually cut by a pair of milling cutters, and the pieces are fed up to the cutters gripped between the two discs shown in the sketch. It will be noticed that one of the discs bears against an oblique bearing, while the other is fixed square on the spindle. The two discs are pressed together by a strong spring and have little recesses to receive the work. The pieces are slipped in place where the discs gape open, and are gripped firmly by the time they get round to the milling cutters. When finished they drop into a tray.

Besides the tools which have been mentioned in these notes, Messrs. Vandervell make a number of others, including tool makers' clamps, squares, tap wrenches, scribing blocks, and so forth, all of which are produced on the same broad principles, and they intend, we understand, shortly to bring out a high-class micrometer gauge. Some views in the works are given on page 544.

Developments in Power Station Design.

No. XXX.*

THE practical application of the laws governing the flow of fluids in pipes associated with power stations has hitherto involved the use of mechanical contrivances, but an electrical system which is claimed to give a high degree of accuracy and which merely involves the use of standard ammeters and watt-hour meters has recently been introduced into this country by Mr. Burton Dunglinson, of 33, Oxford House, 9, Oxford-street, London. In 1921 the Franklin Institute awarded the inventor of the system, Mr. Spitzglass, the gold medal, and records show that the previous occasion on which this Institute made a similar award was in 1899, when Mr. C. Herschel gained the Elliott Cresson medal for his practical application of the Venturi principle. Since that time the improvements that have been made in respect of the measurement of fluids have been mainly along mechanical lines. The electrical system has now, however, been applied to the measurement of steam, water, oil, air, and town, coke-oven, and blast-furnace gas. It has also been used with marked success for the measurement of steam which alternates in direction of flow in pipes during certain periods of the day.

There are two accepted ways of determining the flow of fluids. In one case the frictional pressure drop is taken over a given length of pipe, whilst in the other instance the velocity is converted into pressure by means of obstructions in the pipe or by other arrangements, which give pressure readings that can easily be interpreted in terms of velocity. With the electrical system under consideration the use of Pitot tubes, nozzle tubes, Venturi tubes and orifice plates is permissible, for when these devices are inserted in a pipe through which a fluid is passing they will give manometer readings which can easily be interpreted. The manometer reading must be converted into a form which can easily be read and which will give the rate of flow in accepted units. A simple interpretation would give the rate of flow over an instantaneous period of time, and assuming that the rate of flow is varying continuously, as it does under most industrial conditions, it is necessary to record this change of flow and to integrate it over a given period. The integration is the most important function, and upon the accuracy and design of the integrating mechanism the merit of the instrument depends. In mechanical instruments the recording is done in various ways. The record can be made by the operation of floats, levers or diaphragms actuated by the pressure difference, whilst integration can be performed by a planimeter device which forms an integral part of the meter, or the records can be subjected to a planimeter survey. The electrical method of measuring the flow of fluids, however, completely eliminates all mechanical integrating devices. For obtaining indications and records of the flow, ammeters are used, whilst integration is done by watt-hour meters. These instruments operate independently of each other, and their accuracy is not affected by the dissipation of energy in moving parts.

The principles involved will readily be understood from Fig. 167. A U-tube partly filled with mercury is made to balance the impact pressure of the flow in the pipe by the rise of mercury in the low-pressure side of the tube, and the mercury also forms a part of the electrical circuit in the manner shown. In addition to the mercury, the electrical circuit is composed of a fixed internal resistance R_1, which is connected in series with a variable internal resistance R_2, a constant source of electromotive force E, an ammeter A, and a watt-hour meter W. In the contact chamber C, which forms the low-pressure side of the U-tube, there are conductors of varying lengths which are placed above the mercury column, and as the mercury rises it makes contact with one conductor after another. The variable resistance R_2, it will be noticed, is subdivided by the vertical conductors in the contact chamber C, so that the rise and fall of the mercury column varies the amount of resistance in the electrical circuit, and therefore varies the amount of current flowing. The basic principle of the scheme, therefore, involves the laws which govern the flow of fluids through pipes coupled with those governing the flow of an electric current. In establishing the theoretical relation between these fundamental laws little difficulty was experienced because of the similarity between the units such as pressure and velocity, voltage and current.

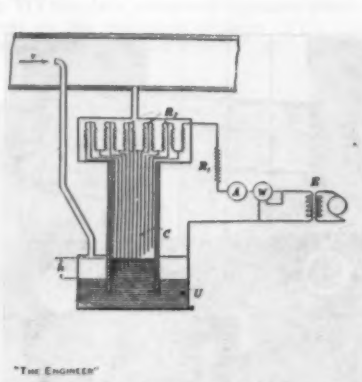


FIG. 167—ELECTRICAL FLOW METER

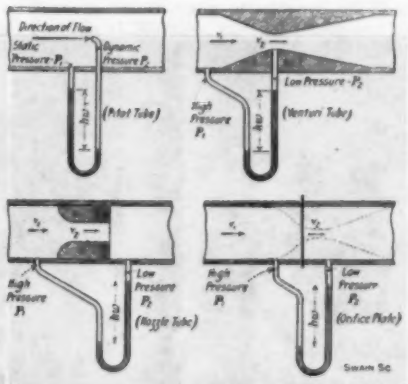


FIG. 168—METHODS OF MEASURING PRESSURE DIFFERENCES

As the level of the mercury established by the flow of the fluid is not impeded by any mechanical device, the accuracy of the system is not impaired, and the complete apparatus is very simple; whilst the range of measurement is from the maximum flow down to 10 per cent. of the flow, which is claimed to be as low as any device based on the differential principle can measure.

A meter body showing the steam and electrical connections is shown in Fig. 169. A Pitot tube or orifice disc is used to obtain the differential pressure, the selection being determined by the conditions of flow. Preference is, however, always given to one or the other of these arrangements, as they do not involve any alterations to the existing pipe work. Moreover, their action is always positive, and there is no possibility of choking. The meter body is connected to the differential arrangement by short lengths of ½in. piping, as shown, for example, in Fig. 170, and a wire is led from the terminal posts of the meter body to the instrument panel, which can be placed at the most convenient point for observation, regardless of distance. A transformer for each instrument supplies the working current at a pressure of 40 volts, and the transformers are fitted at the back of the board which carries the instrument, as showy in Fig. 173. The maximum current consumed by three instruments, used for indicating, recording and integrating, is 3 ampères. A board equipped with meters of these types, and used for measuring water, is shown in Fig. 172.

When there is a flow of fluid in a pipe line the dynamic pressure becomes higher than the static pressure, and the mercury level is depressed in the mercury well and raised in the contact chamber in proportion to the impact of the flow. The resistances are divided by the contact rods, so that the flow of the current in the electrical circuit is directly proportional to the flow of fluid in the pipe, with the result that the electrical energy measured by the flow intergrator is the exact equivalent of the total amount of fluid passing to the pipe. As the action of the meter depends solely upon the confined body of mercury, the slightest change in the flow of the fluid in the pipe gives rise to an immediate change in the level of the mercury column and a corresponding immediate change in the readings of the electrical instruments. A mercury safety seal provides an automatic release which prevents derangement of the elements in the meter body, and is claimed to prevent the mercury syphoning out, and therefore obviates the tedious work of re-filling and re-setting.

The illustration, Fig. 174, shows steam flow meters working on this principle, and fitted to the fronts of boilers so that the stokers can ascertain the amount of work each boiler is doing. The recorder and integrator

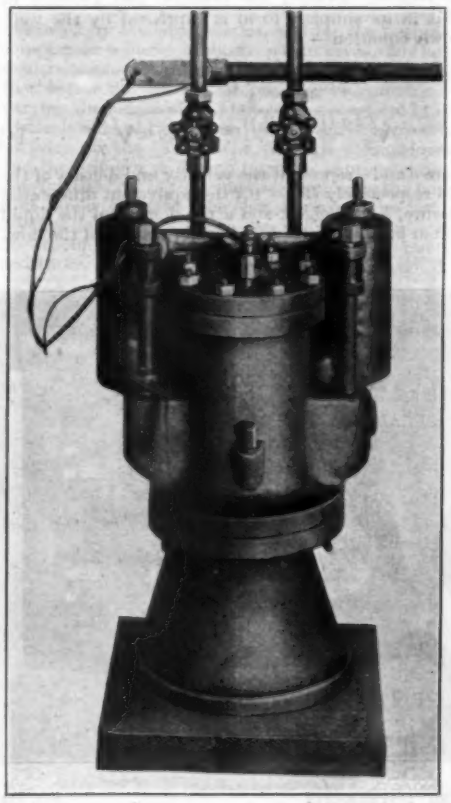


FIG. 169—FLUID METER BODY

* No. XXIX. appeared May 12th.

can, of course, be placed on a centralised board in the engineer's office, as shown in Fig. 175, thus simplifying the work of making up the log and at the same time enabling the engineer to keep an eye on the operation of the plant. The meter body can be placed in any out of the way position, whilst the instruments can be arranged in clean positions and where they can be kept under observation. The problem of measuring steam passing through a pipe in different directions during different parts of the day has been solved successfully by coupling together two meter bodies with a single seal, when correct readings are obtained of the two flows. It is, of course, possible to duplicate any of the instruments connected to a meter body, and, when desired, one master panel with plug switches can be used in connection with any number of meter bodies.

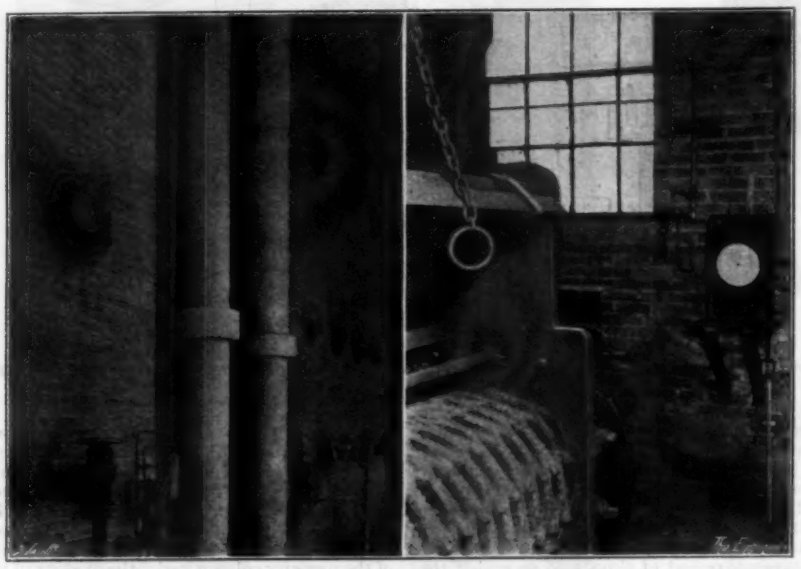


FIG. 170—FLUID METERS

FIG. 171—COMBINED CO_2 AND STEAM RECORDERS

An instrument which has recently developed is shown in Fig. 171. This is a combined CO_2 indicator and recorder and steam recorder, and gives the two sets of readings on the same chart by drawing lines of different colours, the steam readings being obtained electrically in accordance with the principle described.

The fact that the flow of fluids can be measured electrically has led to some interesting developments. In one instance, we are told, a certain firm had been contemplating for a long time past the adoption of a system of measuring the amount of steam, air and water used in its various departments, but was hampered by the fact that the various pipe lines were distributed over a wide area, whilst in some places they were carried through sub-basements where measuring devices would be inaccessible. Much time and labour would, it was thought, be taken up in reading the various instruments in different parts of the works, and in integrating the recording charts with planimeters. But as soon as it was discovered that the flow of fluids could be measured electrically, and that the electrical indicating instruments did not have to be placed at the actual point of measurement, a measuring system was immediately installed and much waste that previously existed is said to have been avoided.

The readings of the watt-hour meter, the makers point out, are more accurate than those taken from the recording ammeter, and just as accurate as the instantaneous readings of the indicator. The use of the watt-hour meter obviates the necessity of using a planimeter on the recorder charts. In connection with the manufacture of water gas by the use of low-pressure exhaust steam, the system has been found to be highly satisfactory. The main advantage claimed for this electrical method of fluid flow measurement is the accuracy with which the differential pressure is transmitted through the mercury column, which, as already pointed out, is not retarded in its movements by any kind of mechanism, and is therefore free to attain the true level under all conditions of flow. Moreover, the electrical instruments used to register the flow can be checked at any time without interfering with the operation or installation of the measuring device.

Coming now to the theoretical side of the subject, the relation between the pressure and velocity of fluids in its simplest form is expressed by the well-known equation—

$$\frac{v^2}{2g}\gamma = P_2 - P_1 = h\,w$$

$$\text{or } v = \sqrt{\frac{2g\,(P_2 - P_1)}{\gamma}} \text{ or } \sqrt{2g}\sqrt{\frac{h}{\gamma}} \quad . \quad [1]$$

where v and γ represent the velocity and density of the fluid respectively $(P_2 - P_1)$ the equivalent differential pressure, h the height, and w the density of the liquid column balancing the differential pressure of the flow. This differential pressure may be obtained as shown in Fig. 168, either by directly balancing the difference between the dynamic and static sides of a Pitot tube inserted in the pipe line or indirectly by balancing the difference between the high and low sides of a Venturi tube, nozzle tube or orifice plate. In the case of the Pitot tube the differential column in the U-tube represents the flow or motion existing at the given section of the pipe line, but in the case of the Venturi tube, nozzle or orifice the column obtained represents the change of motion produced by the artificial obstruction to the passage at the given section of the pipe. In any case, however, the relation between the differential column thus obtained and the velocity of the fluid of the pipe may be represented by the equation [1], provided an experimental coefficient C is introduced, the coefficient being derived from the given tube or orifice. Thus in general

$$v = C\sqrt{2gw}\sqrt{\frac{h}{\gamma}} \quad . \quad . \quad . \quad [2]$$

The volume of the fluid Q passing per unit of time through an area A is given by the equation

$$Q = A\,v = A\,C\sqrt{2gw}\sqrt{\frac{h}{\gamma}} \quad . \quad . \quad [3]$$

the corresponding weight G per unit of time is

$$G = Q\gamma = (A\sqrt{2gw})\,C\sqrt{h\gamma} = KC\sqrt{w\gamma} \quad . \quad [4]$$

and the total weight for a given period of time t is

$$Gt = KCt\sqrt{h\gamma} \quad . \quad . \quad . \quad . \quad [5]$$

Having adopted the foregoing general equations for the flow of fluids, the corresponding electrical measurements may be considered. In the following equations I is the current flowing through the electric circuit of the measuring device, one ampère representing the maximum capacity of the meter. E is the electromotive force of the circuit, and, as already indicated, a uniform pressure of 40 volts is selected to represent the average density of the fluid measured. W t represents the amount of electrical energy expended in the circuit of the meter in a period of time t. R is the total resistance of the circuit in ohms. F is the rate of flow in the pipe corresponding to the current in the circuit or the ratio of G to I, or the indicating factor of the flow meter, whilst T is the total amount of flow or the weight of fluid corresponding to the electric energy passed through the circuit. The ratio of G to I gives T, and is designated as the "totalising factor" of the meter.

Since by definition F I = G and from equation [4]

$$G = K\,C\,\sqrt{\gamma}\,\sqrt{h},$$

therefore $F\,I = K\,C\,\sqrt{\gamma}\,\sqrt{h}$, or

$$I = \frac{K\,C}{F}\sqrt{\gamma}\,\sqrt{h} \quad . \quad . \quad . \quad [6]$$

The value K is constant for any given set of conditions, as determined from equation [4], and the value C, which depends upon the particular design of the tube or orifice, is also constant for any given case. To find the value of F, let I_{max} be the current in ampères corresponding to the maximum capacity of the meter, G_{max}, which corresponds in turn to the maximum differential column h_{max}. From equation [6]

$$I_{max} = \frac{K\,C}{F}\sqrt{\gamma}\,\sqrt{h_{max}} \quad . \quad . \quad . \quad [7]$$

whence

$$F = K\,C\sqrt{\gamma}\,\frac{\sqrt{h_{max}}}{I_{max}} \quad . \quad . \quad . \quad [8]$$

and since I_{max} is equal to unity,

$$F = K\,C\sqrt{\gamma}\,\sqrt{h_{max}} \quad . \quad . \quad . \quad [9]$$

The quantity $\sqrt{h_{max}}$ is called the characteristic or the scale of the given meter, and it determines its capacity in accordance with the amount of the differential column h_{max}, which the meter is able to produce and record. Combining equations [6] and [9],

$$I = \sqrt{\frac{h}{h_{max}}} \quad . \quad . \quad . \quad . \quad [10]$$

From equation [10] it follows that in order to represent the amount of flow the current I should be numerically equal to the square root of the relative height of the mercury column in the U-tube of the meter. From the same equation

$$h = I^2\,h_{max} \quad . \quad . \quad . \quad . \quad . \quad . \quad [11]$$

It will be seen that the height of the column for a given flow is numerically equal to the constant h_{max}

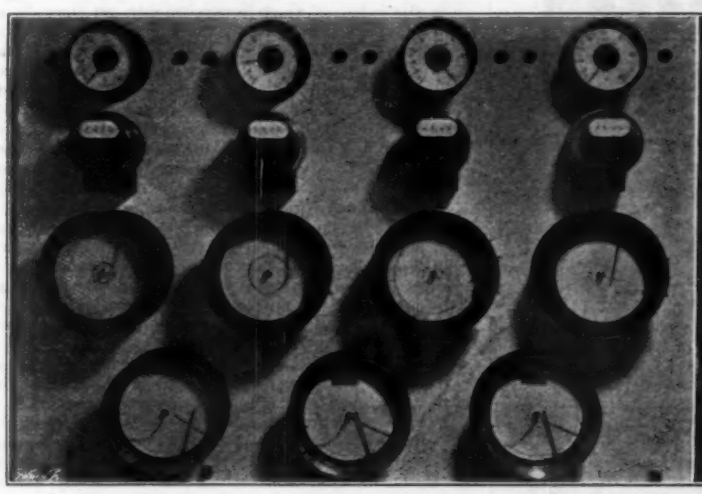


FIG. 172—INDICATING, INTEGRATING, AND RECORDING INSTRUMENTS

FIG. 173—BACK OF INSTRUMENT BOARD

times the square of the current flowing through the circuit.

From Ohms law, which states E = I R, the following is obtained by substitution :—

$$R = E \sqrt{\frac{h_{max}}{h}} \quad . \quad . \quad . \quad . \quad [12]$$

That is, the resistance R in the circuit should be numerically equal to the voltage multiplied by the square root of the relative height of the differential column. It now remains to determine T the "totalising factor" of the instrument or the ratio of G to W. Since $W t = E I t$ and by definition $T W t = G t = F I t$

$$T = \frac{F}{E} \quad . \quad . \quad . \quad . \quad . \quad . \quad [13]$$

The totalising factor of the meter, it will be seen, is equal to the indicating factor divided by the voltage of the circuit. The curves, Fig. 176, shows the relation of the units involved in the electrical measurement of flow. The parabolic curve to the right represents the solution of equation [11], and shows the variations in the electric circuit representing the capacity of the flow and corresponding to the percentage variation in the differential column balancing the velocity pressure of the flow. The hyperbolic curve to the left of the diagram shows the relation between the current and the corresponding resistance at the given voltage of the electric circuit. The solution of equation [12] or the relation of R to h is obtained indirectly by following from a given value of R on the resistance curve to the corresponding value of h on the current and capacity curve. It will be observed that the diagram does not include the first 10 per cent. of the flow capacity, as this represents only 1 per cent. of the differential column, which is as low as a practical device is able to measure with any degree of accuracy, but this disadvantage is offset by the fact that the scale of the flow meter can be chosen so that the desired measurement will fall within the active part of the scale.

The accuracy of a flow-measuring device is necessarily dependent upon two factors, one being the accuracy with which the apparatus registers the differential pressure equivalent to the flow in the pipes, and the other is the accuracy with which it will indicate or record this differential pressure or the equivalent units of flow. In the usual applications of the flow meters where the Pitot tube, the Venturi tube, or the orifice plate is used for obtaining the differential pressure of the flow, the efficiencies of those devices have been determined by numerous tests and are at present well known. Their design is such that a given flow will always produce the same effect under the same conditions, for they do not possess any working parts that are liable to vary the relative effectiveness of their operation. On the other hand, the makers of these electrical instruments explain, the operation of the indicating or recording elements of these devices may vary from time to time according to the condition of the moving parts, and it is therefore necessary to have convenient means for testing them in order to ascertain their accuracy at frequent intervals.

In Fig. 177 the data presented represent those of a typical test on the resistance element of the electric meter, showing the relation between the differential column and the corresponding readings of the electric current. The points obtained from the tests are indicated by the small circles, and for the purpose of comparison a curve is shown which gives the theoretical relations according to the equation $h = 12\, h_{max}$. In this test the differential pressure was obtained by varying the height of a water column connected to the dynamic side of the meter. The electric current was supplied to the instrument through a transformer, and the primary or line voltage was kept constant by varying the field of the generator supplying the power, thus approximating the actual conditions of an average installation. The secondary voltage varied on account of the transformer regulation, but the resistance element of the instrument is designed to compensate for such regulation so that the indicated variations of current gave a fairly accurate measurement of the differential pressure.

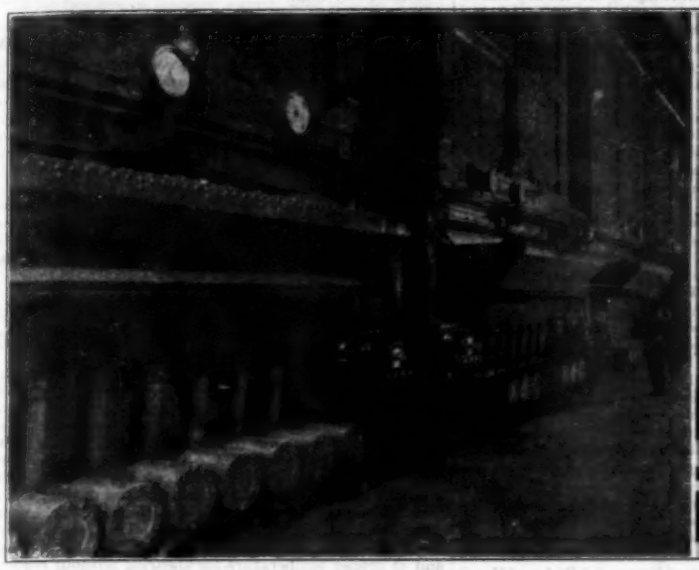


FIG. 174—FLOW METERS IN BOILER ROOM

FIG. 175—CENTRAL INSTRUMENT BOARD IN A POWER HOUSE

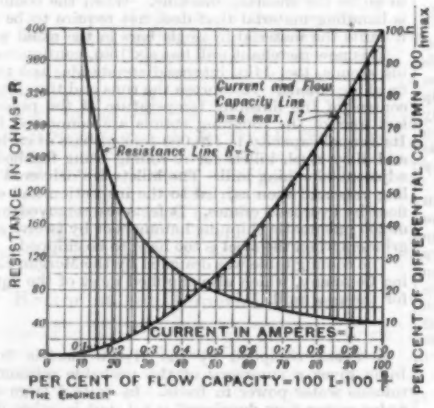

RESISTANCE IN OHMS=R
Current and Flow Capacity Line h=h max. I²
Resistance Line R=E/I
CURRENT IN AMPERES=I
PER CENT OF FLOW CAPACITY=100 I-100 F/E
"THE ENGINEER"

FIG. 176

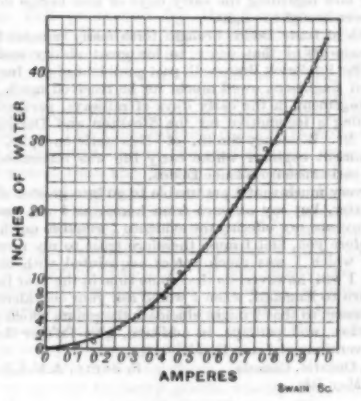


FIG. 177

THE Bawdwin lead and silver mines in the Northern Shan States were, according to the *Indian and Eastern Engineer*, worked by the Chinese for centuries, but were finally abandoned by them some fifty years ago. Their objective being silver, they left behind them huge dumps containing hundreds of thousands of tons of rich lead and zinc slag. In 1910 mining operations were resumed under the direction of European agencies, whose enterprise has been richly rewarded. The ore in the Chinaman lode averages 31 per cent. of lead, 29 per cent. of zinc, and 30 ounces of silver per ton. The output of lead and silver ores in 1920 was 128,908 tons; some 23,821 tons of refined lead and 2,869,727 ounces of refined silver were produced.

Chinese Engineering Notes.

(From our own Correspondent.)

Peking, April 3rd.

WE are still without a Cabinet or Government here owing to the delay in settling the differences between the two principal Military Governors, Chang Tso Lin, of Manchuria, and Wu Pei Fu, of the Yangtse Provinces. The Prime Minister is still in Tientsin, having been granted a further extension of "sick leave." The Ministers of Communications and Finance are dancing attendance on General Chang Tso Lin at Mukden, and the remaining Ministers are in Peking, but can do nothing, although the Minister of Foreign Affairs, Dr. W. W. Yen, is supposed to be Acting Premier. There have been persistent rumours that the Manchurian War Lord (Chang Tso Lin) has been moving troops towards Peking with the object of inducing Wu Pei Fu to attack him, but so far we know nothing officially. In the meantime all Government Departments are in a state of chaos, and no business can be transacted. Those railways, such as the Peking-Hankow and Peking-Suiyuan lines, that are under the entire management of the Chinese, are in a pitiable condition. Every cent that is earned on these lines goes towards the military expenses, and what few civil officials there are can do nothing, and most of them are lucky if they get their pay. Some few years ago the concession for the Peking tramways was granted to the Banque Industrielle de Chine, which bank suspended payment in June last year. The Chinese Government then cancelled the concession, and gave it to a Chinese group, which has recently been inviting tenders. It is generally believed that this so-called Chinese group is really being backed by German capital. Peking has been full of Germans during the last few weeks, most of them being here in connection with this tramway scheme. A number of British firms have tendered, but it is doubtful whether they will be willing to give the easy terms of payment said to have been offered by the Germans.

The mining industry is progressing fairly rapidly, and there would appear to be good opportunities for this class of machinery. During December last no less than twenty mining licences were issued by the Ministry of Agriculture and Commerce in Peking. Those interested in mining in China are making great efforts to induce the authorities to build more roads, and good progress is being made in this direction in some provinces. In the Province of Honan the Famine Relief Committee has consistently used its funds for the employment of labour on road building. This useful work was initiated by Bishop W. C. White, ably backed by the military and civil governors of the province. They have planned to build over 600 miles of roads, of which nearly 100 miles are completed and 200 in course of construction. Motor omnibuses are already running on some of the roads. Ever since the revolution of 1911–12 the Province of Shansi has been by far the best governed of any in China. The Military Governor, General Yen Shi Shan, although a military man by profession, has devoted the last ten years to the economic development of his province, which, by the way, is one of the richest in China. General Yen maintains an army sufficiently large to keep peace in his own province. He never takes part in the annual squabbles which engage the attention of practically all the other military people, and will not permit soldiers of other provinces to cross his frontier. Shansi is also the only province, with the possible exception of Honan, that remits funds regularly to the Central Government. For the last five years General Yen has had some 6000 of his

soldiers engaged on road building. The soldiers like the work, and it keeps them fit; but the most important factor is that Shansi gets its roads built for nothing. A slight tax is imposed on landowners through whose properties the roads are built, but it is paid cheerfully, as the value of these properties is more than doubled.

Shanghai.

The bulk of the machinery requirements of China are those of the railways, as the Chinese cannot be said to own any real large public utility undertaking other than the railways, and even these have been built with about £60,000,000 of foreign capital, at least one-third of which is British. It may, in fact, be said that the Chinese own very little except the ground and the labour potentiality of their nation, and as the ground and labour are not in a position to negotiate for their own development China would revert to a primeval state if all foreign capital were withdrawn. It is asserted that less than one-half of 1 per cent. of the needs of the population of China, which is approximately 400,000,000, are met by machine production or machine work; the great masses of the people are yet living on a home industry or hand labour basis. The Shantung Railway, which was formerly owned by Germany, and which was the subject of very delicate negotiations at the recent Washington Conference, is being returned, or rather "made over" to the Chinese, and the President of the Chinese Republic has declared that it shall be owned by the people. That is a step in the right direction with a view to giving the people a sense of responsibility, and is a very clever move on the part of the President, as, having had his Government subjected to adverse criticism for so long, he practically tells the people to have a try at running public affairs themselves. Dr. C. T. Wang, who was one of the delegates to the Paris Peace Conference, and who is undoubtedly a very able man, with a clear insight into his nation's disabilities, has been appointed Director-General of Shantung affairs, and in taking up that post sounds a note of warning, and admits that but for the Washington Conference China would not have got Shantung back at all, because China did not sign the Peace Treaty, and therefore Dr. Wang says: "It should be borne in mind, however, that unless we afford good equipment to Tsingtao (the sea port terminal of the Shantung Railway) as a commercial port the Powers will in all probability retain permanently the foreign concessions there, taking advantage of such failure on our part, and that if we could not redeem the Shantung Railway we would become an object for public derision." This statement certainly indicates a realisation of what is required, and perhaps the Chinese will some day learn that trade cannot be attracted without good port equipment, and that there is good reason for the foreigner not allowing his property to go to pieces for lack of practical maintenance and efficient administration.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

ISAAC DODDS.

SIR,—I have just received your issue of March 10th last and have read with interest your review on my book, "A Story of Railway Pioneers." I regret very much that I have not with me at the present time the original notes, documents and data which provided the information contained in the book. I may, however, have the opportunity at a later date, when I will be only too happy to place my evidence before your readers.

I had considered very carefully the advisability of giving marginal references to the various sources of my statements. Had this suggestion been finally adopted, however, it is probable that the life-works of Messrs. Dodds would have remained in obscurity if depending on publication by myself. It had been my intention originally to secure for public record the publication of the original MS. in some journal devoted to railway engineering; it was found, however, too voluminous for that purpose. Subsequently it was found possible to publish this matter in book form, and it was considered that the addition of frequent footnotes, containing explanations and numerous marginal references, would detract from the general interest of the book, and that it would be far better to make occasional reference in the text to the sources of information, so that any reader who was deeply interested in our subject could, if he wished, delve further into the statements for himself.

There are in existence at the present time two accounts of Messrs. Dodds' inventions and works, both of them being referred to in my book. The first record is that written by John Guest, F.S.A., in the year 1865–6, for the purpose of a lecture which he actually delivered in the year 1866 before the Sheffield and Rotherham Literary and Philosophical Society. A copy of his lecture—printed in that year—can be seen in the Reference Library, Surrey-street, Sheffield, among local records kept there (see also contemporary local newspapers, *e.g.*, *Sheffield Independent*).

This lecture was also printed and included in a massive volume of historical records of South Yorkshire; it was named "Historic Notices of Rotherham." The subscribers to this volume included many distinguished engineers and men associated with the early days of British industrial development. Statements given in his lecture were secured by Mr. Guest, a gentleman of eminence in his day, from Isaac Dodds, also by inspection of the documents and models which Mr. Dodds was able to keep until either the closing of his works or the end of his life.

A very careful examination of the documents at present in existence and in the possession of members of the family proved without doubt that Mr. Guest copied most of his statements from these papers.

I was informed by members of the Dodds' family that, following his retirement from engineering activities, Isaac Dodds was asked by Charles Manby, secretary of the Institution of Civil Engineers, to write his autobiography, but he could never be persuaded into any kind of publicity.

The second record available is to be found in the "Minutes of the Proceedings" of the Institution of Civil Engineers, 1883–4, and this record was written by Isaac Dodds' eldest son, Mr. T. W. Dodds, and Mr. Charles Manby, of the Institution of Civil Engineers, who, together, examined the drawings, correspondence and other documents, which had been carefully preserved by Isaac Dodds up to the date of his death. From these, and from personal knowledge of his life history, they composed their memoir, which is to be found in the "Minutes of the Proceedings" of the Institution of Civil Engineers for the year 1883–4; and I would again refer any reader to this source of information, as I believe I did in the text of my narrative.

In Chapter II. I have referred to the Monkland and Kirkintilloch Railway; brief reference is made in some rough notes by Isaac Dodds, in his own handwriting, to this railway and to Dr. Gurney's description (Dr. Goldsworth Gurney), and in my book I have referred to a "Treatise on Locomotion," written by Gurney; but a drawing of the locomotives built for this line in 1831 can be seen in the well-known Hebert's Encyclopædia (published about the year 1835), a work which is probably more accessible to present-day readers than Gurney's "Treatise."

Zerah Colburn, in his work on "Locomotive Engineering," refers to Mr. Dodds in his chapters on the "History of the Locomotive Engine" briefly as follows:—

"In even the lengthy summary of locomotive history with which we have now reached the year 1840, the works of a few engineers have been overlooked.

"It might have been mentioned, on a previous page, that the first locomotives made in Scotland are supposed to have been constructed in 1831 by Messrs. Murdoch and Aitken, of Hill-street, Glasgow, for the Monkland and Kirkintilloch Railway. These engines, designed by Mr. Dodds, were of nearly the same construction as the Killingworth engine . . ."

With regard to inventions such as the fusible plug, parallel motion, and inventions for which Isaac Dodds secured recognition from the Society of Arts, I do not think anything further need be written about these, the records of that most noble Society supplying all that is necessary.

My reference to the well-known malleable iron bridge over the Caledonian Railway at the Beattock Summit, which carries the Evan water over the cutting, should arouse much interest, as it deals principally with the history of the first wrought iron plate girder bridge.

Among Isaac Dodds' papers, which the writer carefully examined, there is a clipping made from a letter written to the Wearmouth Bridge Commissioners by the son of the man who claimed to have designed this bridge. Some claim that Tom Paine (Deist, and author of "Age of Reason," "Rights of Man," and an international agitator) designed the bridge. In this letter we are informed that a drawing purporting to be "An original ink drawing of the first iron girder bridge, constructed according to Tom Paine's patent method," could then be seen at the Brompton Museum, No. 54, among the mechanical drawings. This design, according to the writing on the drawing, was made by, and the bridge erected, under the superintendence of Tom Paine at the Holmes Works, Rotherham, about the year 1800. On this clipping there is a footnote written by Isaac Dodds, in which he states that it was presented by him to Professor Woodcroft, Curator of the Patents Museum.

From other notes and from statements made by Isaac Dodds' descendants when I interviewed them eleven or twelve years ago, it must be accepted that Dodds secured these drawings from the Holmes Works, Rotherham, as he had taken over a part of Joshua Walker's foundry there in 1837, and it is well known that Tom Paine had worked for the Walkers on several occasions.

Before leaving England I spent considerable time in searching for this drawing among the examples and drawings of structural engineering at South Kensington Museum, but was unable to locate it. Perhaps some reader now in England, with time at his disposal, could continue the search, as, if he is successful, an interesting fact regarding the early days of iron bridge design will have been brought to light.

The death of Isaac Dodds brought forth many tributes from eminent engineers of that day; to his great ability and his generosity Sir Frederick Bramwell, past-president of the Institution of Civil Engineers, owed much, for he received much help and encouragement in the early days of railways, particularly when building a locomotive for the Stockton and Darlington Railway. Mr. Wasteney-Smith, of Newcastle-on-Tyne, was another eminent engineer whose early life was influenced by advice and assistance from Isaac Dodds.

I regret very much that I am unable to go into greater detail in this matter, but my absence from home, as I am now in Canada, prevents my offering the evidence I would so much like to place before you, and I must therefore trust to my memory for matter which I was much better acquainted with eleven years ago. I will, however, do that some time in the near future on my return to England, when I would ask your consideration of further space, so that I might elucidate the points which your reviewer raises, and perhaps, in addition, give further details of other inventions of Isaac Dodds.

Toronto, Ontario, Canada, May 4th. S. SNELL, A.M.E.I.C.

ORGANISATION AND WAGES.

SIR,—The letter which appeared in your publication of the 5th, by A. Williams Price, indicates that organisation and wages is a problem that embraces many stages of the engineering profession. Scientific management is admitted to be a failure. Why is it a failure? Because it is too scientific, too complicated; the worker does not understand it. One might say we have free education, but it is freely abused. Fifty years ago sport was not the apex aimed at or muscular development, but mental efficiency. The worker of to-day understands the old simple method. Give him a specified number of hours to do a job, at a fixed price, and let him earn what he can; the quicker he accomplishes it the better for his employer. If he performs a 100-hour job in fifty or sixty hours, do not ask him to give his employer ten hours of the time saved, for he will not do it; no more will an employer give his customer a bonus of his contract price if he completes the job in ten days when one hundred days was specified.

The small shop, in "A. W. P.'s" estimation, is a thorn in his flesh. Woe betide our industry when the small shop disappears, for it is in these small hives that the mechanic learns his trade, where he has to use his brains more than his hands, for necessity is the mother of invention. There he is left to the mercy of his ingenuity, to devise ways and means of performing a big job in a small way. It is not the first time the small shop has beaten the big shop in the open market as regards time limit, and if a foreman should attempt to demur, his practical employer will tell him to go and get it done, "So-and-so can do it, therefore so can you." The same remark is applicable to "A. W. P.'s" opinion of foremen. I doubt he must be a factotum, for no employer will keep a foreman who is not competent of doing every job in the trade he has learned. Perhaps he will not do it as quick as the expert workman, but, nevertheless, he can do it. No employer wants a foreman doing all the jobs in the shop; what he wants is a man who knows when a job is being done, or to give instructions how to do it. When the day arrives that our employers appoint a policeman to supervise their respective departments there will be neither big shops nor small ones. It is well known that when the costing department has a doubtful job to estimate for, the foreman's opinion is always the ruling factor, for no one knows better than him the intricacy which it involves.

ROBERT KEDDIE.

Eltham, May 15th.

AVOIDABLE WASTE IN LOCOMOTIVE OPERATION.

SIR,—I would like to ask your correspondent "C. R. K." what he thinks of the 26.9 lb. of coal per 1000 ton-miles, cited in Mr. Partington's paper, as having been obtained in the case of the Virginian 2–10–10–2 Mallet locomotives. It seems to me to be extraordinarily low. Working out the consumption of some American 2–8–2 engines, saturated and superheated, respectively, I found that the "wet" engine burnt 302.2 lb. per 1000 ton-miles and the superheater engines, of which there were two, from 341.2 lb. down to 102.2 lb., on the same basis. In this country, so far as I know, we have not got much below the last-mentioned figure. A rate of only 26.9 lb. per 1000 ton-miles strikes one as being very remarkable.

F. W. BREWER.

Stevenage, May 15th.

PACK COOLING BED FOR A ROLLING MILL.

A MECHANICALLY operated pack cooling table which permits close control of products, such as alloy steel, requiring special treatment during the cooling between rolling mill and shearing machine, is a special feature in the new merchant mill of the Interstate Iron and Steel Company at Chicago, U.S.A. Thus, when cooling spring flats, there is complete control of the time from the finishing rolls to the cooling pack, the size of the pack, the time in the pack, and the time from the pack to the shears. Alloy steels of any desired commercial degree of hardness can be handled, and can be delivered to the shears straight and at proper temperature for shearing without reduction in output or increase in expense.

This pack bed, as designed for the alow cooling of alloy spring steel, is about 300ft. long. It is a combination of a narrow inclined gravity escapement section and a horizontal notched bed section, between which are the jointed packing bars operated by a pair of shafts. The inclined portion of the bed is narrower than in ordinary cooling tables, since the horizontal bed provides the necessary space in which the cooling is completed. Finished material is accumulated in bundles on the packing bars and then transferred by them to the horizontal bed, across which it is moved pack by pack. This arrangement permits the annealing of material of small cross section, which would cool too rapidly if handled in single pieces. It thus avoids subsequent annealing to restore the desired degree of softness in steel which has cooled too rapidly. The packing system has been used before on hand-operated beds, but mechanical packing is a new departure.

In this case the spring flats are from 1½in. to 6in. wide, and the packs or bundles are lifted and carried from notch to notch on the horizontal portion of the bed until they are delivered on the assembling table at proper temperature to go to the shearing machine. When the cooling table is handling material that does not require to be packed, it shifts the material in single bars in the usual way.

This new merchant mill has six 16in. continuous roughing stands, two 14in. intermediate stands, and two 12in. finishing stands. To shorten the runs and thus give better control of the finishing temperature of the product, the last four of the roughing stands are connected in pairs. Its annual capacity is 120,000 tons of bars of carbon steel and alloy steel, billets for re-rolling being finished by the adjacent blooming mill. The billets are delivered to pickling vats and then carried to the inspection and chipping floor by overhead cranes. Defects are removed by means of 200 pneumatic chipping hammers or by twelve swinging grinders when the steel is too hard to be chipped.

The cooling table was designed by the Morgan Engineering Company, which also supplied most of the equipment for the new mill.

A TABLE compiled by the Hydro-Electric Survey of India gives a summary of the probable minimum continuous water power in India. In quite a large area the water power now developed is nil, but in other divisions the probable amount is fairly large. In Assam, for example, it is 414,000 kilowatts, of which 109,000 are obtainable in areas investigated but not developed. In Bihar and Orissa, the corresponding figures are 62,550 and 12,550, and in the Central Provinces they stand at 137,560 and 13,700. In Bengal out of a probable total for minimum continuous water power, amounting to 669,850 kilowatts, only 600 kilowatts are in a developed state, 14,250 are in areas investigated but not developed, while the largest portion of the province remains to be investigated. Worse still are conditions on the North-West Frontier, where with a probable total of about 1,000,000 kilowatts, only 250 are developed. In the United Provinces, including the Canals, the figures are 403,370 and 4330 respectively. Burma also shows a very backward condition, the actual development being 3370 kilowatts out of a probable total of nearly a million. It may be remarked that the plant under construction is only for 55,640 kilowatts, of which 50,000 are in Bombay, 4500 in Mysore, 1000 in Gwalior, and only 140 in the United Provinces. Summing up the figures for all the provinces, the report states that of a probable total, 5,582,300 kilowatts, only 213,140 are now developed.

A Seven-Day Journal.

The Late Mr. William Abraham.

THE death of Mr. William Abraham—or "Mabon," as he was more familiarly called—removes a figure which, until recent years, exercised an important influence in mining circles, especially in the South Wales district. He was born in 1842, the son of a pitman, and except for a very short period of attendance at Carnarvon National School, was entirely self-educated. Until he was thirty-one years of age he was actively engaged as an underground worker. In 1873 he became a miners' agent, and in due time rose to be President of the South Wales Miners' Federation and treasurer of the Miners' Federation of Great Britain. From 1885 to 1918 he represented the Rhondda Valley district in Parliament, and from 1918 to 1920 sat for West Rhondda. As a miners' leader he acquired great authority among those whom he represented, and was accorded deserved respect by all with whom he had to deal. He lent his weight against violent methods of composing disputes, and greatly preferred peaceful negotiations to the drastic arbitrament of the strike. After the strike of 1875 had been settled by the adoption of a sliding scale for the fixing of wages—a means of settlement which he did much to bring about—it was by his influence that the miners were brought to respect the agreement for a period of over twenty years. He died at Cardiff on the 14th in his eightieth year.

Another Scottish Hydro-electric Scheme.

A BILL is now before a Select Committee of the House of Lords, in which the Corporation of Ayr seeks power to augment its existing steam electric generating capacity by tapping the water power of Loch Doon. It is proposed to raise the level of the loch by 5ft., thereby submerging about 200 acres of land and creating a storage capacity sufficient to serve the scheme and provide at the same time a daily minimum flow of six million gallons in the river below the loch down to the point at which the water abstracted would be returned from the power-house. The fall available is 120ft. in a distance of three-quarters of a mile. The total cost of the scheme, if carried out, is estimated at £220,000, and the time required to complete the works at two years. Mr. J. H. Rider, electrical engineer, of Westminster, is acting as adviser to the Corporation in connection with the matter. There is considerable opposition to the Bill, chiefly on account of those interested in the effect of the scheme, if carried out, on the fishing rights. During the war, it may be recalled, large sums of money were spent by the Government in carrying out works at Loch Doon with the object of providing a seaplane and flying boat experimental station.

The Midlothian Oil Find.

FURTHER information regarding the discovery of oil at D'Arcy, near Dalkeith, is now available. According to a reply given in Parliament by the Secretary for Mines, oil was met on the 6th inst. at a depth of 1810ft. The oil-bearing formation was penetrated to an extent of 10ft. On the 9th the oil had risen 170ft. in the bore-hole. The estimated cost of the drilling operations at D'Arcy is £42,298. That for the West Calder bore-hole, which was abandoned at a depth of 3918ft., is given at £50,202. The oil from the D'Arcy bore-hole has been subjected to analysis, and is stated to be of excellent quality, with a high percentage of petrol, kerosene, and lubricating oil. It has a specific gravity of .819 at 60 deg. Fah.

New Rector of the Imperial College.

IN succession to Sir Alfred Keogh, who is retiring from the rectorship of the Imperial College of Science and Technology at the close of the summer term, the governors have appointed Sir Thomas Henry Holland to fill the post. Sir Thomas is chiefly known as a geologist, and has held several important positions, particularly in India. In 1888 he was awarded the associateship in geology of the Royal School of Science. For ten years he was professor of geology and mineralogy at Manchester University, and incidentally served on many commissions and committees concerned with oil. Latterly, in India, he was appointed to the directorship of the Geological Survey, was made President of the Industrial Commission and of the Board of Munitions, and more recently became a member of the Governor-General's Council.

The National Council for Inland Waterways.

THE report issued in June, 1921, by Mr. Neville Chamberlain's Committee appointed by the Ministry of Transport to consider the whole question of inland waterways, led within a short time to the dissolution of the Inland Waterways Association. Whereas the Association favoured the nationalisation of all the inland waterways so as to constitute them one undertaking, the Committee recommended that the waterways should, like the railways, be split into separate groups, and that the group constituted by the river Trent and its connections should be studied and developed first, with a view to gathering experience. The Association was dissolved because it was felt that it could no longer continue to apply the support received from the country as a whole to the development of only one particular area. On the 12th inst., a National Council for Inland Waterways was formed at a meeting in Birmingham presided over by Mr. Neville Chamberlain. The Council has for its object the development of the canal systems in general, but is not committed to any particular method.

Aircraft and Lightning.

MUCH discussion in the past has centred round the effort to forecast what would happen to an aeroplane in the event of its getting directly into the path of a lightning flash on its way to the earth. Speculation on this subject would now appear to have been set at rest, for on a trip between London and Paris recently Captain E. D. C. Herne seems to have encountered the experience when half-way across the Channel. While travelling round a thundercloud, Captain Herne saw one or two bright flashes of lightning close at hand. The machine trembled and seemed to be outlined for a moment in flashing light. Thereafter it recovered and proceeded normally without either the pilot or mechanic suffering any hurt or inconvenience. It is believed that the machine came into direct line with a flash of lightning, but that as there was no direct connection with the earth the current simply passed through it and down the trailing wireless aerial without causing damage to the machine or those on board.

Summer Courses for Engineering Teachers.

THE Board of Education has announced that short courses of instruction for selected teachers of engineering science and electrical engineering will be held at Oxford University and Oxford Technical School between July 22nd and August 5th. The instruction in engineering science will be given by Professor F. C. Lea, of Birmingham University, and that in electrical engineering by Professor W. M. Thornton, of Armstrong College, assisted by a staff of tutors and instructors. The courses will be restricted to thirty-five teacher-students in each. Those qualified to apply for selection are teachers engaged, or intending to engage, in instructional work in technical and junior technical schools. Financial assistance towards travelling and boarding expenses is to be rendered by the authorities.

Railways and Road Traffic.

THE Bill promoted by the London and North-Western and Midland Railway Group, under which full powers are sought to run road traffic across the country, came before a Committee of the House of Commons on Tuesday. There is much opposition to the Bill, over fifty petitions having been presented against it. The Committee's inquiry is not expected to be completed before the end of next week. It is to be noted that the North Staffordshire Railway, a member of the group, already possesses the necessary powers, and that the Scottish railways included in the group are promoting a similar Bill of their own. On behalf of the promoters of the Bill now under examination it is urged that they do not desire the railway companies to be given the monopoly of road goods transport traffic, but that they should not be prevented from participating in it. At present the companies have powers to carry goods by road provided any part of the journey, however short, is made by rail. They have no power to carry goods wholly by road direct from the consignor to the consignee. The opponents of the Bill include the various motor unions and associations, many Corporations and County Councils, the Federation of British Industries, the London Chamber of Commerce, and certain road transport companies.

The Late Professor H. M. Howe.

NEWS has just been received from America that one of the best-known figures in metallurgical circles has passed away in the person of Professor Henry Marion Howe, University of Harvard and Professor Emeritus of the Columbia College, New York. His life-long devotion to the science of metallurgy has made his name a household word in his own country, Great Britain and the Continent. Professor Howe's integrity and honesty of purpose made his scientific, technical and educational work of special value to the world in which he moved. Nothing of doubt was ever allowed to pass his scrutiny. In scientific metallurgy he stood almost unrivalled. Amongst his many contributions may be specially mentioned his great work on "The Metallurgy of Steel," which appeared at a most opportune time, and without doubt greatly helped to develop the science of metallurgy, which was then emerging from its comparatively chrysalis state, into the well-ordered branch of science which it now occupies. He was also the author of innumerable papers on metallurgical subjects. In 1895 he received the Bessemer Gold Medal of the Iron and Steel Institute and the Elliot Cresson Gold Medal of the Franklin Institute of Philadelphia; also a special prize and gold medal from the Société d'Encouragement pour l'Industrie Nationale, and finally, in 1917, the John Fritz Gold Medal, which honour was received by Lord Kelvin in 1905, Sir William White in 1911, and last year by Sir Robert Hadfield. He also received several foreign orders, including the Chevalier of the Legion d'Honneur, France, and the Order of St. Stanislaus, Russia. Professor Howe was a Fellow of the American Philosophical Society and the American Academy of Arts and Sciences. He not only took an interest in metallurgy on the scientific side, but was also greatly instrumental in assisting in the practical development and introduction of manganese steel into the United States.

Woolwich and the Government.

FURTHER to our note in our issue of the 5th inst., we have now to record that Captain Robert Gee, V.C., one of the members of Parliament for Woolwich, has advanced a scheme for the improvement of the borough's industrial position. According to Captain Gee, Woolwich contains the richest factory site within fifty miles of London. The Arsenal covers an area of about 2000 acres, and has a river frontage of 2½ miles. The area during the height of the war employed 102,000 hands, but by the end of this year it will be supporting not more than 8000. The Government, in Captain Gee's view, should be compelled to concentrate its activities on to a fraction of the ground it now monopolises, and should let the remainder, including the river frontage, for private enterprises. He intimated that he had people behind him who were ready to finance the scheme.

Developments in Aerial Transport.

WITH the inauguration of the Amsterdam and Brussels air services on Monday last, the traffic at the London Air Station has now reached record figures so far as the number of machines arriving and departing is concerned. The first aeroplane leaves for Paris at 5 a.m., and until dusk there is a constant succession of arrivals and departures, one machine on the average leaving the station every hour. As illustrating the growth of interest in aerial travel, it may also be recorded that the Cunard Company has now arranged with the Compagnie Aérienne Française to run a service of fast aeroplanes between Cherbourg and Paris in connection with the arrival and departure of the company's Transatlantic liners. By means of this service approximately five hours will be saved by those journeying to or from Paris.

The Engineering Lock-out.

FOLLOWING the publication of Sir William Mackenzie's report an invitation was sent by the Employers' Federation to all the unions concerned in the dispute to meet the employers in conference on Tuesday. Without exception, the unions, including the Amalgamated Engineering Union, accepted the invitation, and with every desire to settle the dispute expressed by both sides, the conference opened at Broadway House, Westminster, on the morning of the 16th. After preliminary discussions regarding procedure, the employers undertook to submit on the following day definite proposals for the consideration of the unions. These proposals were duly presented on Wednesday, and, we understand, revealed a genuine wish on the part of the employers to remove some of the objections to the memorandum of last November advanced by the men's representatives at the Court of Inquiry; but yesterday afternoon the announcement was made that the A.E.U. had broken away from the negotiations. It is understood that the employers have agreed to give notice of the introduction of any material change in workshop practice or routine, and to allow a limited period for discussion before it actually comes into operation.

The T.S. King Edward.

IT is of interest to record the fact that the King Edward, the first turbine steamer constructed for commercial purposes, has recently been brought up to date in the matter of her propelling machinery with a view to increasing her efficiency. A trial run took place on the Clyde last week, and during its course it was demonstrated that the vessel's steaming and manœuvring qualities had been greatly improved. The King Edward, it may be recalled, saw much war service, and took part in the expedition to Archangel.

A Visit to Carels' Factory at Ghent.

No. II.*

CAREL FRERES were one of the original firms which in 1893 obtained the right to work the patents of the late Dr. Rudolph Diesel, and we show in Fig. 9 the first single-cylinder experimental engine built by them in 1894. During the twenty years which preceded the war the Carels' design of Diesel engine had achieved an important place among both the land and marine developments of this type of prime mover.

DIESEL ENGINES.

On the occasion of our recent visit to Ghent it was of historical interest to see two types of engines which belong peculiarly to the period of pre-war design and which, while typical of a certain phase of development, have now given place to engines of later and improved construction. The first of the engines to which we refer is one of the two 1500 brake horse-power two-stroke cycle slow-speed reversible marine engines which were ordered by the British Admiralty with a view to installing them in a 10,000-ton tanker for the purpose of comparative trials. In accordance with the specification the engine was of the marine type with open crosshead guides and separate cylinder jackets and liners. Valve scavenging was adopted, and the pumps supplying the scavenge air were driven along with the various auxiliary pumps by links from the main crossheads. A Reavell multi-stage air compressor driven from the crank shaft and placed at the forward end of the engine supplied the injection air. A thrust block was provided at the aft end of the engine. In general, the design presented some interesting features, and we understand that a wide

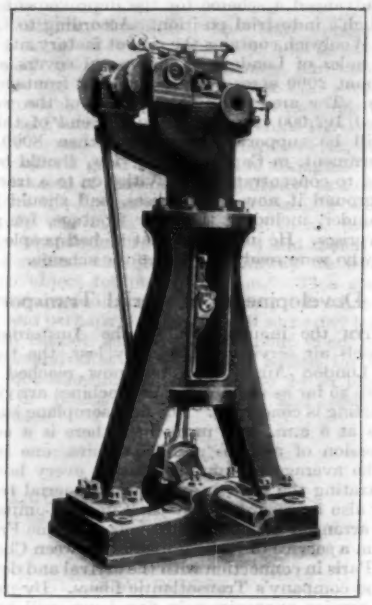


FIG. 9—EXPERIMENTAL DIESEL ENGINE

speed range was attained and the engine responded quickly to control during reversing operations. This pair of engines were approaching completion at the commencement of hostilities and it was not possible to deliver them. Late in 1914 they were confiscated by the German military authorities who immediately despatched one engine to the Krupp works. The engine we saw remained at Ghent and, in view of the firm's forthcoming new marine developments, it will most likely eventually be used as a stationary engine.

The second engine was an example of high speed construction with a somewhat unfortunate history. About 1912, at the express request of the late Diesel Engine Company, Limited, it was agreed by Carels to build a series of quick running engines of light design. Several of these high-speed engines were made, but they were never really satisfactory, and are no longer manufactured. The example we saw was built to the order of the late Consolidated Diesel Engine Company, Limited, and was left on the hands of Carels Frères on the liquidation of this company.

The standard Carels' Diesel oil engines as at present manufactured may be divided into two classes, the four-stroke cycle engines and the two-stroke cycle engines. We illustrate in Fig. 10 an example of the former group. In this engraving one of the five-cylinder engines is shown in course of erection, this unit developing 750 brake horse-power at 160 revolutions per minute or 150 brake horse-power in each cylinder. The cylinders are 21in. in diameter and the piston stroke is 30½in. Fig. 12 shows a four-cylinder 600 brake horse-power engine of the same type, and the sectional plan and elevation there given enable us to refer to some of the main features of the design. The A type column has been retained and the design is such as to maintain an unbroken line from the foot of the column and the top of the cylinder casing, thereby imparting increased rigidity to that part of the column to which the cylinder cover is bolted. We noted that the crank shaft is built up, the portions forming the two crank cheeks and crank pin being machined from a solid forging and pressed on to those portions of the shaft which form the main bearings. In the engines seen, an outboard bearing was provided and the fly-wheel, which is made in halves and dowelled together, is secured to the crank shaft by shrunk rings only. The liners, we understand, are cast from special metal. A useful provision is the large number of inspection doors both on the cylinder columns and covers, which allow of free and ample access to water spaces for examination and cleaning. The size of cylinder does not exceed that in which air cooled pistons can safely be used, and the flow of heat to the crosshead pins is minimised by fitting a separate piston head of special cast iron. Each piston is furnished with seven piston rings, six of them being on the piston head and one low down on the piston skirt.

In examining the cylinder cover, it was noted that the air and exhaust valves and fuel valves are placed off the centre line by which means more efficient cooling and a stronger cylinder cover is obtained. The air intakes are situated to the left of each cylinder on the engine centre line, and three of them are connected to the column and bed-plate spaces which are enclosed by light steel covers, the end cylinder taking its air direct from the engine-room. An alternative balanced system has been evolved whereby all cylinders draw from a common air main which is connected both with the column and bed-plates paces and also directly with the atmosphere. This method ensures a drying of the air, and at the same time allows a circulation of cool air around the cranks and assists in piston cooling. The exhaust outlets are situated at the back of the cylinder cover and water-cooled exhaust pipes are carried down through the platform to the trench leading to the silencer. It will be noted that starting valves are fitted on the two middle cylinders only. All the valve levers are of the split type which greatly facilitates the withdrawal of valves and valve casings for inspection without dismantling the levers on the fulcrum spindle. The exhaust valves are water cooled and the tops of the valve guides on both the air and exhaust valves are lubricated. The fuel pump, which is of the horizontal type, is fixed alongside the cam shaft and governor casing just above the platform, and delivers the fuel to distributors on the cylinders. Apart from sight feed lubricators fitted on various parts of the engine, a special gravity feed system supplies oil to the main bearings and cylinder liners and the supply is replenished by its own lubricating pump. The air compressor, which is attached to the main bed-plate at the end of the engine, is a three-stage compressor with two opposed two-stage cylinders. The two low-pressure stages of each cylinder together form the low-pressure stage of the compressor.

Figs. 13, 14 and 15 show one of the 2000 brake horse-power two-stroke cycle engines on the test bed; the cylinder diameter is 27½in. and the piston stroke 41½in. In this large unit where each cylinder develops 500 horse-power, it has been found desirable both for lifting and transporting to build the engine in sections of reasonable size and weight. Referring to Fig. 13, it will be noted that the bed-plate is made in four sections and that the two supporting columns are separate from the cylinder casing which is bolted to them. Each cylinder casing is furnished with an exhaust belt to which the water-cooled exhaust main is attached. A cylinder cover of patented design is used, the special feature being that the underside of the cover is protected by a steel face. It is claimed that this device has eliminated the cracking of cylinder covers which was experienced in early designs of two-stroke cycle engines with valve scavenging. In addition to the usual fuel and starting valves each cylinder cover is furnished with four scavenge valves, the method of operation being such that one lever operates two valves. Water-cooled pistons are used on the two-stroke cycle engines. Fig. 15 shows the scavenge pumps and air compressor which are compactly grouped together at one end of the engine, the three-stage air compressor being attached to the side of the main supporting column and driven from the scavenge pump crosshead by links. The vertical shaft drive is taken from the centre of the engine and the governor, which is of the Hartung type, controls the fuel

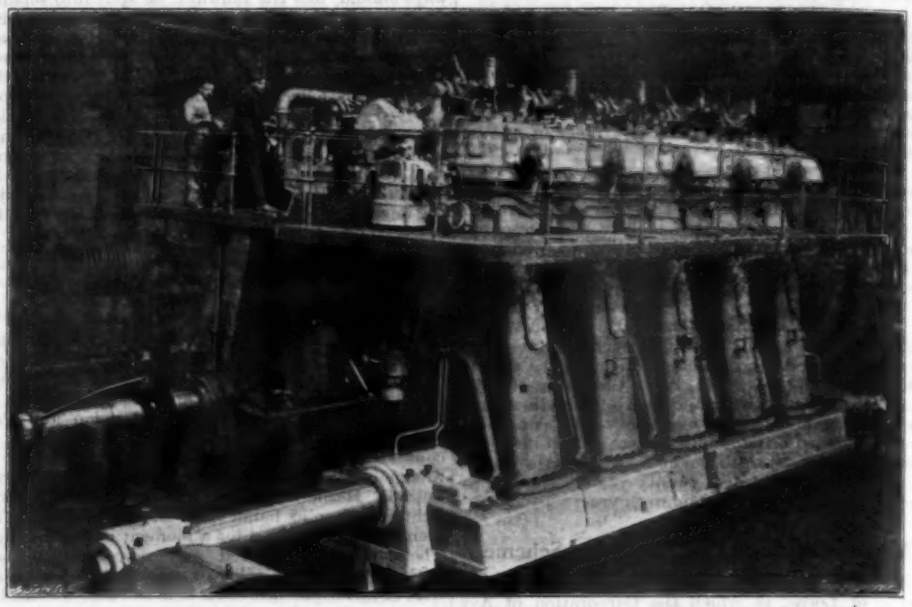


FIG. 10—750-B.H.P. FOUR-STROKE CYCLE DIESEL ENGINE

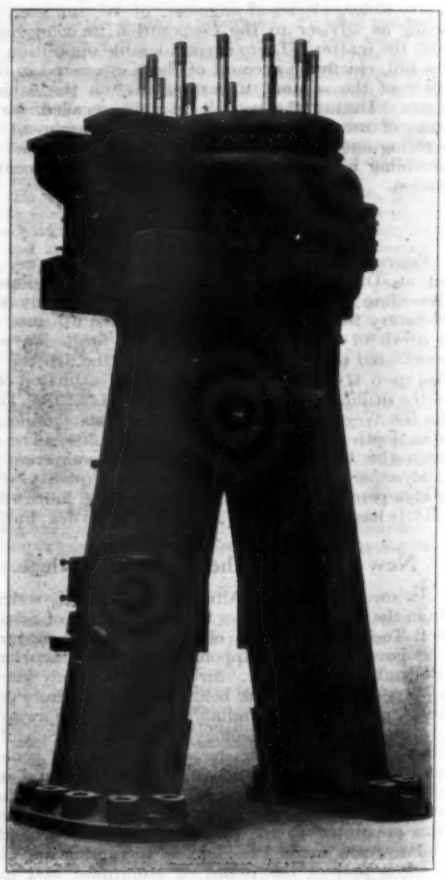


FIG. 11—MAIN COLUMN AND CYLINDER CASING

pumps in the usual way. The 250 brake horse-power per cylinder size of engine is of similar design to the engine we have just described, with the exception that in this engine the main column and cylinder casing are in one casting. Fig. 11 shows one of these columns in course of completion. New types of engines have occupied the attention of the company for some time past, and interesting tests, of which we are unable

* No. I. appeared May 5th.

to give any details at the present moment, are being carried out.

STEAM ENGINES.

The Carels' design of drop valve steam engine is well known, and it was not surprising to find several engines of the single cylinder and cross compound types, and also tandem and uniflow engines in course of completion.

Simplicity of design with a view to reliability is a characteristic of the Carels' steam engine. We noted, on the other hand, that expensive construction is adopted wherever necessary with the object of obtaining the best possible results. Thus the engine main frames are generously proportioned with foundation support along their entire length, which greatly adds to the rigidity of the bed-plate and results in freedom from vibration, which is especially desirable in engines which may run at such speeds as 125 revolutions per minute. Arrangements are provided whereby the lower guide bearing of the crosshead is cooled by water circulation, and the cooling water is further passed round the main bearing so as continuously to cool the lubricating oil in the well of the bearing. With regard to the main bearings, it is the general practice to make the main bearing brasses in four pieces to allow for normal wear by means of adjustment of the side parts, one of these bearing against two screws. The method of adjustment which we believe is solely used by Carels is such that the fore part of the shell bears against a steel wedge along its entire length, the wedge being capable of a fine adjustment in a vertical direction so that the necessary fit is obtained. This method holds the shell rigidly throughout its length, so that it cannot bend, as it may do, when, as in the ordinary design, it is supported by two screws only. This is an important point in design, since the total load carried by the bearing is that resulting from the pressure of steam on the pistons, and any bending of the bearing will give rise to unsatisfactory results. In all engines running at more than 100 revolutions per minute, duplicate lubrication is provided for the main bearings, each lubricating system having sufficient capacity to meet the requirements independently of the other system. The bearings are provided with ring lubrication, the oil wells being water cooled as previously mentioned, and, in addition, a rotary pump draws lubricating oil from the wells and delivers it to a sight feed lubricator with a regulated delivery. Ample lubrication is thus maintained under all conditions.

For some years it has been Carels' practice to support the engine tail rod on a sliding shoe instead of a fixed guide, and to give initial camber to the piston-rod, so that when the piston is assembled on its rod, the flexure due to its weight brings the piston into correct alignment, allowing it to float in the cylinder. A special lathe is employed for turning the piston-rods, and by means of an ingenious device the finished piston itself serves as the weight which imparts to the rotating turning head the movement to produce the required camber. This method of piston-rod construction has proved very successful in use, as it not only greatly reduces the wear on cylinder walls, piston and piston rings, but it also assists in maintaining perfectly tight stuffing-boxes, since the piston-rod moves in a horizontal line, which remains constant under any condition of expansion of the cylinders, whether along the length of the engine or in a lateral direction.

The same method of piston-rod support is used on the tandem engines, an intermediate connecting piece of strong construction, which carries the guide for the moving shoe, being interposed between the high-pressure and low-pressure cylinders. The views which we reproduce on page 554 serve to illustrate this and also to show the general construction of the cylinders and valve gear and the manner in which the intermediate slipper and the tail-rod slipper are supported. This engine, which was recently installed by Carels Diesel and Steam Engines (London), Limited, Carlton House, Regent-street, at the Mossley Mill of the Egmont Spinning Company, Limited, Manchester, is of the Carels' tandem compound type. The guaranteed steam consumption of the engine, with steam at 150 lb. per square inch and 275 deg. Cent. superheat at the stop valve, is 4.5 kilos. or 9.92 lb. of steam per brake horse-power hour. The details of the valve chests and valve mechanism are shown in Fig. 16. We would point out that the inlet valves are fitted with a special liner, and the shape of the valve seat is such that a sharp cut-off is given, but at the same time all shock is eliminated from the valve at the moment when it closes. The valves are accommodated in a separate casting which forms at the same time the valve chest and the cylinder cover, and this construction not only reduces the clearance space to a minimum but has a beneficial effect due to the heating of the end walls of the cylinder. The main cylinder body is a plain circular casting, and in the case of the

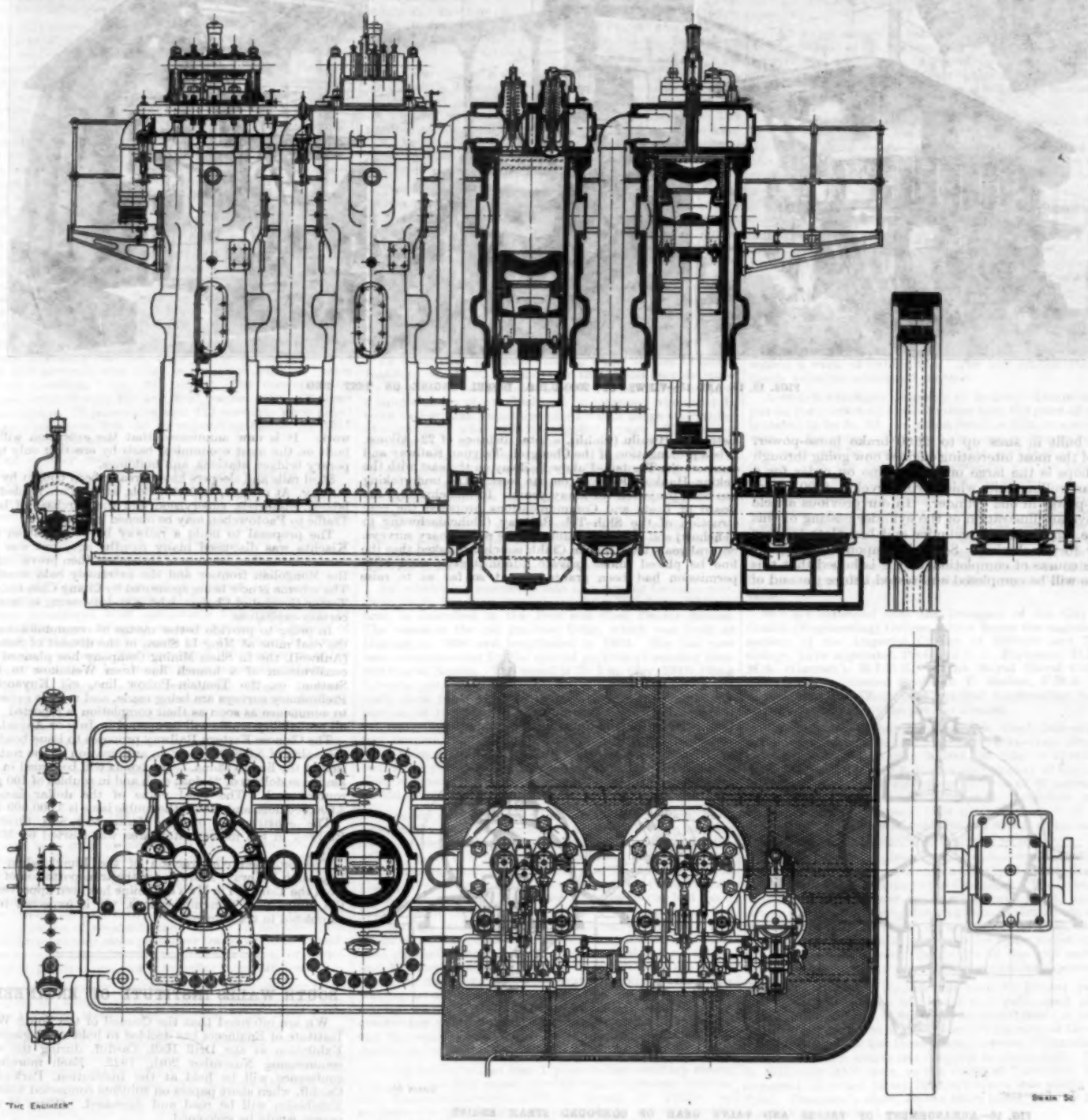
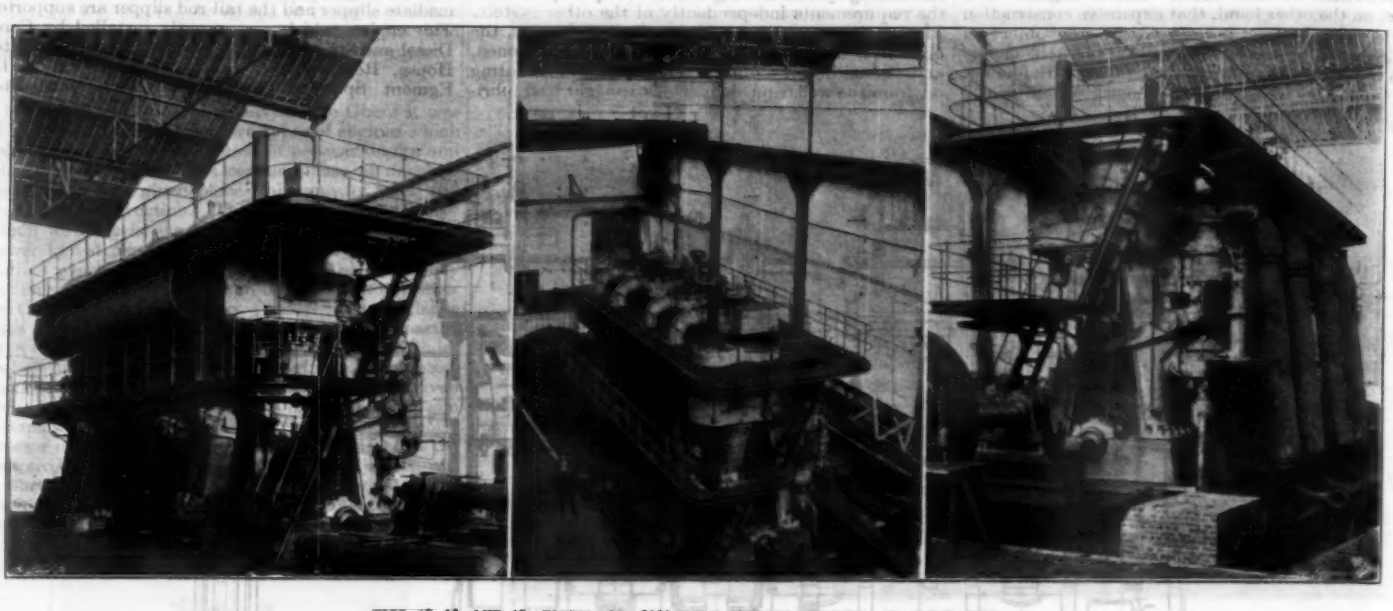


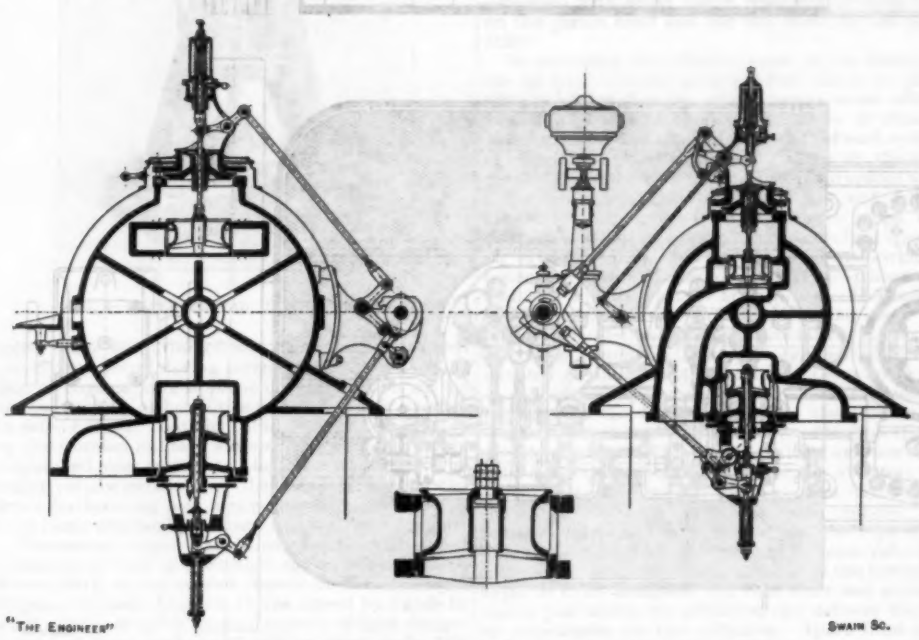
FIG. 12—600-B.H.P. FOUR-STROKE CYCLE DIESEL ENGINE

low-pressure cylinder it is fitted with a steam jacket, and, in accordance with Carels' standard practice, the air pumps are driven from the main crank shaft by means of link gear and not from the tail-rod of the engine.

In addition to the types of steam engine we have already mentioned, considerable work has been done on the perfecting of the Carels' uniflow engine, and many successful engines of this type have already been built in sizes up to 2500 brake horse-power. One of the most interesting engines now going through the shops is the large uniflow engine on order for a Belgian rolling mill which will develop 4000 brake horse-power in one cylinder. In our previous article we gave an illustration of the cylinder casting of this engine, and both the cylinder and bed-plate are now ready for machining. Several component parts are in the course of completion, and it is hoped that this engine will be completed and tested before the end of the year. At a later date we look forward to giving some particulars with regard to the design and performance of this large unit.



FIGS. 13, 14, AND 15—VIEWS OF 2000-B.H.P. DIESEL ENGINE ON TEST BED



"THE ENGINEER" SWAIN Sc.

FIG. 16—ARRANGEMENT OF VALVES AND VALVE GEAR OF COMPOUND STEAM ENGINE

IT is reported from Brussels that the management of the Belgian railways is occupied in fixing the model of the new type of passenger carriages. A Committee of Directors has visited the chief workshop at Malines to inspect the two carriages under construction. These coaches are intended for use in Belgium only; one has a central corridor with second-class compartments and lavatory and one first-class compartment and lavatory, while the other, which is entirely third-class, has also a central corridor and lavatory. The Committee has decided to continue the construction of these coaches, and has also found it worth while to continue the construction of two other coaches, one containing both first and second-class compartments with a side corridor and double lavatory, the other being for third-class passengers with a side corridor and lavatory.

Railway Construction in China.

THE following particulars of the most recent railway construction schemes in China are furnished by the Government Bureau of Economic Information of that country.

The Tsangchow–Shihchiachwang (Tsang–Shih) Railway, of which the road bed has now been completed, starts from Tsangchow (Chihli) and ends at Shihchiachwang, in the district of Hwailu (Chihli), a total distance of 224 kiloms. It is a prolongation of the Chengteh–Taiyuan Railway and connects the Tientsin–Pukow Railway on the east with the Peking–Hankow Railway on the west. The undertaking has been projected for many years. In Manchu days the Board of Posts and Communications proposed the construction of the Shih–Teh Railway (Shihchiachwang to Tehchow) and was responsible for the preliminary surveys. Several years later certain Chihli merchants asked that the line be placed under private administration and after permission had been granted, went so far as to raise capital. In 1917 the Ministry of Communications cancelled the concession to the merchants and nationalised it. Although the administrations of the Peking–Hankow and the Tientsin–Pukow lines made all the necessary preparations, the construction of the line was suspended. Then in September, 1920, the Ministry of Communications decided to alter the route from Shihchiachwang–Tehchow to Shihchiachwang–Tsangchow. Famine labour was employed, and after a year's work the road bed is now completed. The Peking–Hankow and Tientsin–Pukow Railway administrations divided the responsibility between them. The districts through which the line will pass are Hwailu, Chengting, Kaocheng, Tsinchow, Shenchow, Shulu, Wukiang, Sienhsien, Kiaoho, Tsinghsien and Tsang-chow. There are altogether eighteen stations. The road-building expenses, estimated at 1,840,000 dols., were appropriated from the proceeds of the surcharge on posts, telegraphs, and railways, an appropriation which was augmented by a gift of 100,000 dols. by the British-American Tobacco Company for famine relief. From the commencement of the work till the end of December, 1921, the actual cost was as follows:—General, 147,490.58 dols.; preparation, 17,935.37 dols.; land purchase, 940,647.92 dols.; road bed, 435,379.45 dols.; transfer charges, 616.98 dols.; giving an aggregate of 1,542,070.30 dols. The land used in the districts of Shengting, Shulu, and Tsanghsien has still to be paid for, but it is not anticipated that the original estimate will be exceeded.

The Suiyuan–Paotowchen section of the Peking–Suiyuan Railway, which was estimated to cost 6,746,000 dols., was to be opened to traffic last September, but lack of funds and the early frost at Suiyuan have delayed the work. It is now announced that the extension will be built on the most economical basis by erecting only temporary bridges, stations, and buildings.

Steel rails and sleepers have already been bought by the railway. At present, 1,255,000 dols. at least are needed for labour, materials, supervision, and the purchase of land. Traffic to Paotowchen may be opened in October.

The proposal to build a railway between Kalgan and Kiachta was discussed many months ago, but was not carried into effect because of the unrest then prevailing on the Mongolian frontier and the extremely cold weather. The scheme is now being sponsored by Chang Chin-hui, the Tartar-General of Chahar, who is endeavouring to interest certain capitalists.

In order to provide better means of communication to the coal mine at Ming Li Shan, in the district of Suhsien (Anhwei), the Li Shan Mining Company has planned the construction of a branch line from Weikikow to Fuli Station, on the Tientsin–Pukow line, *viâ* Kuysochih. Preliminary surveys are being made, and work is expected to commence as soon as their completion is reported. In all probability traffic will be opened in July or August.

The Chinese Eastern Railway proposes to issue bonds to the value of 5,000,000 dols. in anticipation of the restoration of the line to China. The bonds will be issued in two kinds: in dollars of 25 dols. each and in roubles of 100 gold roubles each. The total value of the dollar issue is 2,000,000 dols. and that of the rouble issue is 3,000,000 dols.

The construction of the Mentaokow and Chaitang Railway in the metropolitan area was started on March 20th.

The proposed construction of the Lungkiashan and Lopushan Railway, Anhwei, for the transportation of coal from the Tangtu Yih Hwa coal mine has been approved by the Ministry of Communications. It is expected to be completed in six months.

SOUTH WALES INSTITUTE OF ENGINEERS.

WE are informed that the Council of the South Wales Institute of Engineers has decided to hold an Engineering Exhibition at the Drill Hall, Cardiff, during the week commencing November 20th, 1922. Each morning a conference will be held at the Institution, Park-place, Cardiff, when short papers on subjects connected with the Exhibition will be read and discussed. Offers of such papers would be welcomed.

The Exhibition will be opened each day at two o'clock p.m., and will comprise the following sections:—

Section 1.—Scientific, measuring and recording instruments as applied to all branches of engineering.

Section 2, *Steam Section.*—Water-softening and cooling plant; boilers and equipment; oil burners; pipes, valves, separators, &c.; drawings of models of modern engines; governors and safety devices.

Section 3, *Electrical Section.*—Switchgear, cables, controllers, &c.; overhead lines; electrical tools and other appliances; small motors; electric cranes; telephone and wireless apparatus.

Section 4, *Mechanical Section.*—Mechanical transmission of power; bearings, clutches, ropes, belts, gearing, &c.

Section 5, *Workshop Appliances.*—Machine tools, small; pneumatic tools; hydraulic tools.

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Railway Matters.

ON June 12th, the London and North-Western Railway Company will restore the pre-war through service between Liverpool, Manchester and Birmingham and the Kent coast stations on the South-Eastern and Chatham.

A FEW days ago the line from Zurich to Sargans was the scene of tests made by the Swiss Federal Railways of a turbine locomotive manufactured by the firm of Escher, Wyss and Co., Zurich. The results with regard to water and coal consumption are reported as being good.

THE statement giving particulars of the guarantees, under the Trade Facilities Act, 1921, sanctioned by the Treasury up to March 31st, includes five millions for the London Underground Railway Company and six and a-half millions for electrification on the South-Eastern and Chatham.

IN 1921 the electrification of the Swiss Federal Railways cost a total of 244,000,000f., of which about 175 millions were used in works construction and 68 millions for electric locomotives. At the end of 1921 the Federal Railways still had a stock of 464,000 tons of coal, which cost them 78.7 million francs, or the high average of about 170f. per ton.

THE Italian State Railways authorities have announced that the limit of the period for the reception of tenders for the electrification of the Bologna-Venice-Monfalcone line, fixed previously for April 30th last, has been postponed until July 31st, 1922. Offers received before April 30th will be returned in order that they may be re-presented before July 31st.

MENTION was made in this column of our issue of May 5th to the unsatisfactory financial results accruing from the Ealing extension of the Central London Railway. As from the 1st instant certain fares are reduced, and this should make the prospects better. The line, being partly Great Western, has its fares based on main line charges, and could not, therefore, adequately compete with the District Railway.

PRELIMINARY figures issued by the Inter-State Commerce Commission show that during the year 1921, 205 passengers and 1096 servants were killed in train accidents or "train service accidents" i.e., by trains. The corresponding figures for 1920 were 229 and 2107 respectively. Of these latter figures, 76 passengers and 422 servants were killed in train accidents, but the corresponding figures for 1921 are not yet available.

THE railway companies have now submitted to the Rates Advisory Committee their proposals as to the classification of traffic, other than perishables, conveyed by passenger train. Copies of these proposals can be obtained from the secretary to the Railway Clearing House, post free, for sixpence. A preliminary meeting of the Committee to discuss the proposals will be held on Tuesday, the 23rd instant.

IN view of the establishment of railway councils on British railways, it may be of interest to know that, during the year 1921, similar bodies on the Pennsylvania system considered 6196 complaints from employees, of which 3729 were adjusted or compromised in favour of the men, 2314 were withdrawn, and 43 decided in favour of the management. The remaining 110 cases were either dropped or were to be brought up in some other shape.

THE retirement is announced of Mr. Henry Jackson, the telegraph assistant to the chief mechanical engineer of what was the Lancashire and Yorkshire Railway. Before going to that line in 1889, Mr. Jackson was on the Furness Railway for eleven years, and was one of the pioneers in electric lighting, having equipped Ramsden Dock with three separate Siemens dynamos, supplying current to three arc lamps on the top of 80ft. lattice iron standards.

DURING the year 1921 the Ministry of Transport held seventeen inquiries into train accidents, besides one accident to a gang of platelayers and the Buxton boiler explosion. This number compares with 25 inquiries in 1920 and 30 in 1919. Of the 1921 inquiries, seven occurred in the first half of the year, which period, it should be remembered, covered the coal dispute of April, May and June—itself, no doubt, the leading factor in the reduction in the number of accidents that had to be inquired into. In all the seventeen cases passenger trains were concerned; there were no inquiries into collisions between, or derailments of, goods trains, nor into buffer stop collisions.

A CORRESPONDENT, writing to the *Railway Age* (New York) on the subject of rough riding passenger cars, concludes his letter thus: "On the other hand, when I ride in an English passenger coach, 70ft. long and weighing less than 40 tons, I appreciate how comfortably it rides, how all the shocks and noises are deadened. The reason is that the designer deliberately tried to do it. The wheels, for instance, have a wooden filler between the hub and rim; the long wheel base of the truck, the long springs making contact with the truck frame through rubber blocks, all contribute to the desired end. We frequently criticise the British for not profiting by our methods of handling freight. Why don't we profit by their way of handling passengers?"

ACCORDING to the Board of Trade returns, the value of the railway material exported during the three months ended March 31st, 1922, was as follows, the corresponding figures for 1921 and 1920 being added in brackets:—Locomotives, £2,111,946 (£1,798,069, £795,485); rails, £1,009,336 (£1,046,264, £386,691); carriages, £470,992 (£322,396, £286,202); wagons, £1,480,961 (£1,616,059, £1,338,764); wheels and axles, £381,792 (£537,141, £473,778); tires and axles, £169,095 (£436,566, £317,135); chairs and metal sleepers, £645,221 (£519,895, £100,327); miscellaneous permanent way, £459,290 (£831,136, £541,487); total permanent way, £2,733,351 (£3,487,113, £1,831,268). The weight of the rails exported was 94,943 tons (44,616 tons, 22,339 tons), and of the chairs and metal sleepers 43,627 tons (22,401 tons, 4702 tons). Locomotives of the value of £172,592 were shipped to India during March, the other outstanding shipments being:—Countries in Europe other than Spain, £162,190; Argentina, £52,050; other South American countries, £31,019. Rails to the value of £189,499 went to India.

Notes and Memoranda.

SOME idea of the great size to which the trees of Western America attain may be gathered from the fact that one Douglas fir recently felled measured 9ft. in diameter at the butt end, while the lowest limb was 200ft. above the ground. The tree provided 43,000ft. board measure.

LOSS by evaporation from the petrol storage tanks in the Panama Canal Zone has been greatly reduced by protecting them from the heat of the sun by means of conical roofs, while the sides are screened by a series of sloping shades. The result is an appearance somewhat resembling a squat pagoda.

WRITING on the subject of transport in South-West Africa in the *Bulletin* of the Federation of British Industries, a correspondent out there says "there is not a single steam car in operation, and I am of opinion that when these are developed and placed on the market at a moderate figure, transport difficulties will be within reasonable distance of being solved."

THE bursting of a superheater tube, working in connection with a Lancashire boiler in a Glamorgan cement factory, was caused, according to the official report, by its wasting away through erosion and overheating. The gradual wasting of the tubes in superheaters of this kind is to be expected, and it appears necessary to remove a tube occasionally for examination after the apparatus has been in use for any lengthy period of time.

TWO years ago the record size hydraulic turbines, 35,000 horse-power, were installed on the American side of Niagara Falls; last year, the record passed across the river and international boundary to the 55,000 horse-power units of Ontario's Queenston plant, and now the Americans are about to build what the *Engineering News Record* describes as the largest water wheels ever attempted, the 70,000 horse-power reaction turbines for an extension which will not only contain these record wheels, but be fed by a remarkable syphon tunnel of the largest rock section ever built, with the exception of the huge ship tunnel at Marseilles, France.

IN describing a gravel-washing plant to the Concrete Institute, Mr. E. F. Sargeant said that it had been designed for continuous work, and it has been found better to have a simple cheap plant which can be scrapped when unduly worn rather than expensive plant which keeps everything at a standstill when it is undergoing repairs. The bucket elevators are of very simple design, consisting of flat bars, 1in. wide, each end of which is bent round a mandrel to form an eye; four or five of these flat links are assembled with a pin at each end, and with spaces between each link of the same width as the link, to form one section of the chain, and the next section, of course, having the links placed alternately with those of the preceding ones. The links lie on the flat, not on their edges, and the buckets are bolted directly to them. The links are of mild steel, and the wear is stated not to be excessive.

AN interesting reconstruction of a former German warship, which has been carried out for a Hamburg shipping firm, is described in the *Iron and Coal Trades Review*. The vessel is the old gunboat Odin, which was built at Dantzig in 1896 and lengthened in 1903. She has now been reconstructed for the special purpose of sending locomotives to Russia. The vessel is 79.1 m. (say, 264ft.) long between perpendiculars. All decks above and below the main deck have been cut off, with the exception of a portion of the forecastle, poop and bridge. The vessel can accommodate on the main deck nine locomotives and two tenders, and seven tenders in the hold amidships. The steam engines have been removed and replaced by two four-cycle Diesel engines, each with six cylinders. Each engine is designed for an output of 400 horse-power at 350 revolutions per minute.

A MINOR explosion on a Cardiff steamer, which, however, might have been serious, was caused by the wasting away of the shell plating round a drain plug. In the official report it is pointed out that the plug was covered with lagging, and judging from the appearance of the shell plate in way of the mounting, it is thought that leakage between the mounting and the plate had been taking place previous to the date of the explosion, but the leakage must have been comparatively slight. The boiler water was generally slightly saline, and it is probable that galvanic action between the brass of the mounting and the steel plate was set up, in which case the plate would be destroyed at a comparatively rapid rate. This wasting would probably be assisted by the contact of the lagging with the plate. Owing to the leakage, the non-conducting material would become saturated with moisture and the conditions in these circumstances would be conducive to corrosion by rusting.

THE failure of a cast iron T piece in the auxiliary steam pipe of a Blue Star vessel, through water hammer, induces the Engineer-Surveyor-in-Chief, Board of Trade, to reiterate the precautions which should be taken to avoid such accidents. He says: If a pipe range is found to contain water of condensation, the drain cocks should not be opened, or, if obstructed, cleared of obstruction until the boiler stop valves have been shut. The latter should then be opened very slightly, just sufficient to blow the water out of the range, but not sufficient for the steam to escape in dangerous quantities in the event of a shock of water hammer and fracture of a pipe occurring. The danger to life is not the shock of the water hammer, but the rush of steam in great volume from the boilers through the pipe or valve which has been fractured by the shock. In a closed compartment, such as a boiler-room on board ship, access to the boiler stop valves cannot be obtained until the steam in the boilers has wholly or nearly wholly escaped, and even if, as in some few instances, the valves can be closed from the deck above, the escape of steam of a few seconds is quite sufficient, if the valves are fairly wide open, to injure fatally anyone who cannot instantly escape from the compartment; hence the importance in first closing the stop valves and then opening them the smallest amount possible to permit of a gentle clearing of the pipes of water and heating of the range. When the range is clear of water and heated up, the stop valves may be opened with safety.

Miscellanea.

SOME new plant which has recently been imported from England by the Namaqua Copper Company, South Africa, will enable it to manufacture and export bar copper.

THE lead mines at Laxey, Isle of Man, which were worked continuously for 140 years, but closed down in May, 1920, are to be reopened at an early date. At one time 800 men were employed there, and the lead ore produced was acknowledged to be among the best in the world.

ACCORDING to a report in the *Sinwanpao*, General Wu Pei-fu has given an order to four German engineers in Shanghai to carry out proposed improvements at the Hanyang Iron and Steel Works. The Germans are stated to have left Shanghai for Hankow to inspect the works in question.

THE water supply of San Francisco is to be augmented to the extent of 24 million gallons per day by the construction of a 5ft. pipe line some 30 miles long. About 8500ft. of tunnelling will be required, and a submarine pipe for half a mile. The scheme is estimated to cost over 4,000,000 dols.

TWO separate companies have recently been organised in the Shantung province of China. One will expend about half a million sterling on electrical enterprises along the route of the Kiachow-Tsinan railway, while the other, with a capital of over £300,000, is to develop mining industries in the district.

AT an electric automobile show which was recently held in New York, there was exhibited an electric taxicab, known as the Electrocar, and manufactured by the Electrocar Corporation. It accommodates five persons in addition to the driver, and is said to have an operating capacity of 60 to 70 miles on a single battery charge.

WE are informed that a second and revised edition of "Notes on the Corrosion and Protection of Condenser Tubes" has just been issued by the Corrosion Research Committee of the Institute of Metals. The first edition of 1000 copies of this practical pamphlet was exhausted within a week of publication. The new edition contains much valuable additional matter.

A SUGAR-REFINING company of Sydney, Australia, has put on the market an alcohol motor fuel, the price of which is stated to be 3s. 3d. per gallon retail in tins, as compared with 4s. for petrol. It is said that one million gallons of this spirit will be available this year, and that if it finds favour with the public, arrangements will be made to increase the production and lower the price.

IT is reported from Shanghai that construction work in connection with a harbour in Hulu Isle, in the Bay of Lienshan, Fengtien Province, which has been under consideration for many years past, has been resolved upon, and work will be begun before long. The cost of the work is estimated at 10,000,000 dollars, and is to be defrayed by the Fengtien Province and the Ministry of Communications.

WE are informed that the Delegacy of the City and Guilds (Engineering) College, which forms the engineering section of the Imperial College of Science and Technology, have appointed Professor C. L. Fortescue, O.B.E., M.A. (Cantab.), M.I.E.E., of the Royal Naval College, Greenwich, to succeed Professor T. Mather, F.R.S., who is resigning the Chair of Electrical Engineering in the College at the close of the present session.

WE understand that the Carnegie Steel Company is about to erect a second by-product coke-oven plant at Clairton at a cost of from 30,000,000 dols. to 35,000,000 dols. The new plant will double the capacity of the ovens already in blast, and will cover an area of 65 acres. It will comprise fourteen batteries with sixty-four ovens each, giving the company 1664 ovens with a total production of 29,952 tons of coal charged a day, or an annual production of about 11,000,000 tons of coke.

A BRIEF account is given in the *Engineering News Record* of an accident which occurred during April at the Niagara Falls plant of the Ontario Power Company. The generator of a 20,000 horse-power water wheel unit burst, putting out of commission a neighbouring unit of similar capacity and causing the shut-down, on account of flooding, of four 16,000 horse-power units. Some of the flying pieces struck the roof trusses, causing the failure of the roof and the consequent destruction of some of the auxiliary apparatus.

BEFORE the war, Switzerland used to import yearly 20,000 to 25,000 tons of tinned and galvanised plates with a value of from 12,000,000f. to 14,000,000f., of which about 60 per cent. was of British and 20 per cent. of German origin. During the last three years, however, Switzerland's demand for this article has dropped to about half. Thus in 1921 only 9556 tons, to the value of 7,400,000f. were imported, in which Great Britain's share was about one-third. Germany's share, on the other hand, went up from one-fifth to one-third.

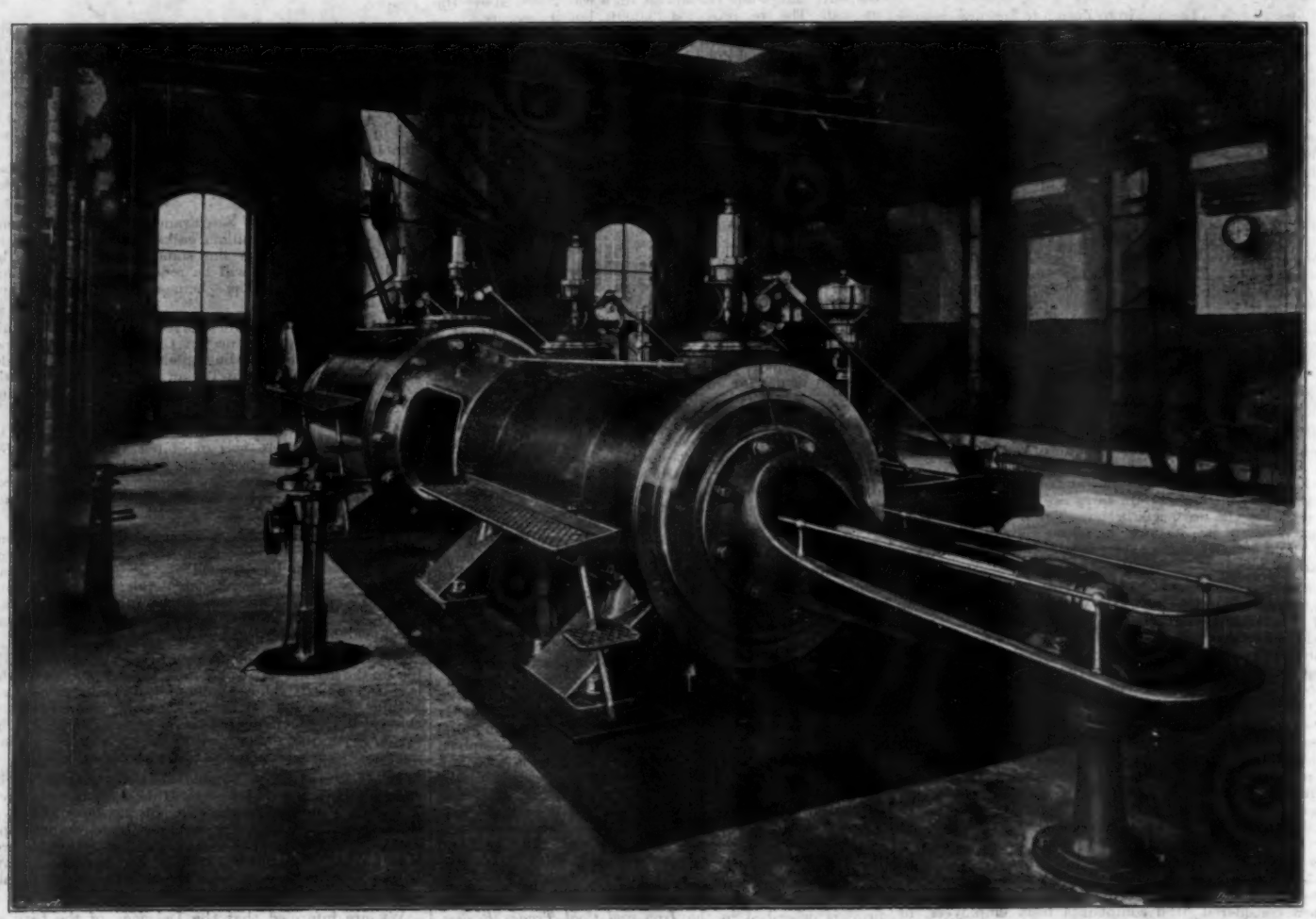
IT is reported by the National Federation of Iron and Steel Manufacturers that the production of pig iron in April amounted to 394,300 tons, or 4500 tons more than in March. The production included 152,900 tons of hematite, 124,700 tons basic, 80,800 tons foundry, and 16,700 tons forge pig iron. The furnaces in blast at the end of April numbered 112, compared with 107 at the end of March, and an average of 284 in 1920. The production of steel ingots and castings dropped in April to 404,200 tons from 549,400 tons in March.

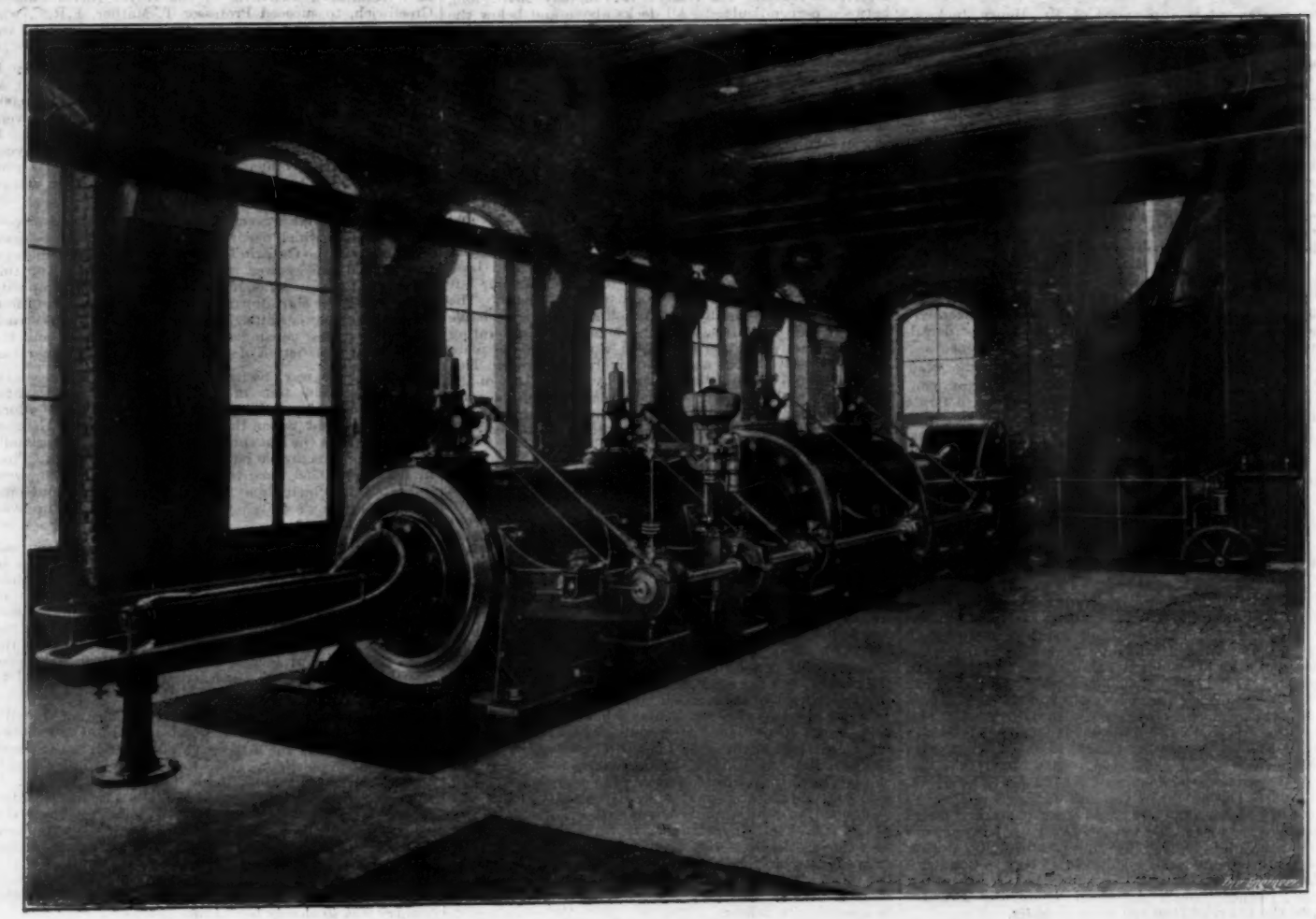
THE war memorial erected in the office of Lloyd's Register of Shipping, in Fenchurch-street, to the memory of the members of the Society's staff who fell in the Great War, was unveiled on Thursday, May 11th, by Field-Marshal the Right Honourable Lord Methuen. Mr. J. Herbert Scrutton, the chairman of Lloyd's Register, stated that 111 members of the Society's staff had joined the colours during the Great War, and that of them fourteen did not return. The numbers would have been increased had it not been for the Government's recognition of the intimate association of the Society's staff with the mercantile marine, with which the safety and welfare of the country was so closely bound up.

1500-B.H.P. TANDEM COMPOUND DROP VALVE ENGINE

CAREL'S DIESEL AND STEAM ENGINES (LONDON), LIMITED, ENGINEERS

(*For description see page 550*)





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Small Advertisements cannot be inserted unless delivered before TWO o'clock on Thursday afternoon (the day before publication). ALTERATIONS to STANDING ADVERTISEMENTS must arrive not later than THURSDAY of the week preceding publication.

Letters relating to Advertisements and the Publishing Department of the Paper are to be addressed to the Manager, all other letters to be addressed to the Editor of The Engineer.

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*** *All letters intended for insertion in* The Engineer *or containing questions should be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever can be taken of anonymous communications.*

*** *We cannot undertake to return drawings or manuscripts; we must therefore request correspondents to keep copies.*

By arrangement with Reuter's Engineering Service, **The Engineer** *contains the latest news from all parts of the world which is likely to be of interest to engineers*

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THE ENGINEER.

MAY 19, 1922.

Railway Rates.

It is difficult to form a definite judgment as to whether or not the railway companies would have been justified in giving greater concessions in railway rates than those which come into force on Monday next, the 22nd instant. Arguing the matter from the trader's point of view, there is much to be said for such an all-round reduction as that urged by the Federation of British Industries. There is, for instance, the fact that the increases which came into operation on September 1st, 1920, were based on the necessity for raising, within eleven months, sufficient increased revenue to wipe off a sixteen months' deficit, and thus to make the companies self-supporting, as from August 1st, 1921, in anticipation of the Government control ceasing on the 15th of that month. As reported by the Rates Advisory Committee in July, 1920, there was, for the period April 1st, 1920, to July 31st, 1921, an anticipated deficiency of sixty-six millions, and to meet this deficit fares were increased to bring, in twelve months, an additional seventeen millions, and rates to bring, in eleven months, forty-nine millions. Thus for each £100 per month deficit, £131.25 had to be raised, and the present fares and rates are, practically, still on that basis. Then, at that time, railway wages were approaching the peak point. The cost of living was 150 per cent. above the July, 1914, datum, but on April 1st last it was 86 per cent. over that datum. Rates were advanced in September, 1920, and the railwaymen's wages were increased, under the sliding scale, by two shillings per week in October, 1920, and by one shilling in January, 1921. Since then there have been four reductions, amounting, in the aggregate, to fifteen shillings per week. In addition, the extra pay, varying from 4s. to 7s. 6d. per week, given by the National Wages Board on June 4th, 1920, is gradually to be withdrawn. Allowing that each shilling per week per man means one million pounds a year, wages must now be at least twelve to fifteen millions a year less than when rates were increased. On the top of this gain is the agreement with the unions that, in many cases, the eight hours' day may be "spread over," thus allowing one man, with a spread-over day, to do work for which two men are needed, and two men to do the work of three. Then, besides a much reduced wages bill, there is a great fall in the cost of material, stores and coal; the last can now be purchased for 21s. per ton. Beyond all these advantages, there are the large sums—all revenue—received from the Government during the control period for arrears of maintenance and renewal, much of which, being for labour in inspection and supervision, cannot now be spent on that work; the larger part of the thirty millions paid by the Government in January last; and the whole of the second thirty millions to be paid at the end of this year, in settlement of all claims. Finally, there is the fact that in view of grouping, and the necessity for presenting a strong financial position, the companies are spending no more money than can be helped; no capital expenditure means no interest to be found, whilst money can be saved by the postponement of large renewals and of those alterations which are classed as revenue charges. Altogether the trader can make out a good case for a general reduction in rates.

Had the railway companies to give an answer to such arguments as those just advanced they would probably open their case by observing that good business was as necessary to them as to the trader. They might even admit that railway charges were the key to the industrial situation. Having conceded these points, they would probably then point out that, according to the preliminary figures issued by the Ministry of Transport at the end of March, there was, despite these higher rates and falling wages and prices, a loss of nine and a-half millions on the railways last year. That loss was, of course, mainly due to the three months' coal stoppage, but trade is now much worse than a year ago, even when compared with the coal dispute period. Furthermore, there are no certain signs of an immediate improvement. In view, then, of the present state of affairs and the uncertainty of the future, how can we—the companies might say—make any wholesale reductions? Unfortunately, the companies cannot offer figures to confirm their argument, as no one knows what are their net receipts to-day. No longer are the monthly statements of receipts and expenditure issued by the Ministry of Transport and the weekly traffic returns are worse than useless as they cannot present the comparative figures of last year. Moreover, they give no indication as to whether expenditure is growing or declining. Added to these adverse causes there is, what is perhaps only natural, a hesitancy to drop prices in view of the standing each company must have when its terms for entering its designated group are under discussion. Fortunately, these terms will, in most cases, be settled before the end of the year, so that this obstacle to a reduction in rates is only temporary, and it is fair to assume that as soon as the terms for grouping are agreed upon, that reason for retaining the higher charges will be less necessary, and the trader is likely then to benefit. Meanwhile, the companies have done something. In January last the rates for coal, coke, iron and steel and for raw material used in the manufacture of iron and steel were lowered to an extent which, it is stated, will reduce the railways' annual revenue by ten million pounds, whilst the concessions that come into operation on Monday next are said to mean a further loss of four millions. Next to reductions in every item in the classification this is the best step, inasmuch as the entries now being dealt with will affect the widest possible area. It must be remembered, too, that the companies plead the dispute in the engineering industry as one reason for staying their hand. Were it settled, there would be hope for further concessions. Let traders, then, be content, for the time, with the present small mercies.

It may be some comfort to know that American railway shareholders and traders are much worse off than those in this country. The American rates were increased on two or three occasions, the last being in August, 1920, and practically no reductions have been made. When the Government took over the railways in December, 1917, the Federal Control Act, sanctioning the transfer, specified that the property was, when it was returned, to be in as good condition as when received. Then, under the Transportation Act, 1920, when the railways were returned on March 1st, 1920, the companies were guaranteed a certain net income for the next six months. It seems hardly credible, but many companies are still awaiting a settlement for compensation due to the shocking neglect of the line and equipment during the twenty-six months the railways were under Federal control, and most of them await also the promised guaranteed income. During the International Railway Congress in Rome, our representative there heard much about the disgust of American railway officers, traders and the public generally with the operation of the United States railway during those twenty-six months. No wonder they were turned back to private operation long before the time specified in the Federal Control Act! The nationalisation of the American railroads is as

"dead as a door nail," and Federal control there furnishes a warning to all those who have any tastes in that direction.

Protective Apparatus for Turbo-Alternators.

HITHERTO the manufacture of electrical protective gear has been more or less a specialised business, which has not received very much attention from the makers of electric generators; but in consequence, no doubt, of the increase in the size of turbo-alternators and the need for adequate protection in high-capacity stations, the large electrical firms are beginning to take a keener interest in this class of gear. The General Electric Company, for instance, is now manufacturing the McColl biassed protective apparatus, whilst Mr. J. A. Kuyser, of the Metropolitan-Vickers Electrical Company, has devised, in conjunction with Mr. J. R. Beard, two special systems which are described in the abstract of his paper which is published in this issue. The importance of properly protecting large generators scarcely needs emphasising. As the cost of re-winding a machine with a capacity of only 5000 kilowatts is somewhere in the neighbourhood of £1500, it is evident that from this standpoint alone the provision of protective apparatus is worth considering. To the cost of the repairs must be added the trouble and possible loss which may arise whilst the repairs are being undertaken. Provided protective gear is not unduly complicated or expensive, there cannot be much question as to its value, for although modern turbo-generators seldom burn out, complete immunity from the trouble cannot be ensured. In some instances flames from alternators that have taken fire have been known to reach the roof of the power-house, and not only have the windings been destroyed, but the core of the machine has also been damaged.

But it is improbable that Mr. Kuyser's latest "mid point" protective gear, which is described in the paper to which we have alluded, constitutes the final solution of the problem of disconnecting alternators from their bus-bars under fault conditions. Although the scheme has been designed to operate under all conditions which are liable to cause damage, including occasions when faults occur between turns, it unfortunately introduces complications which were not overlooked by those who took part in the discussion on the paper. The most severe critic was Dr. S. P. Smith, who urged that it ought to be possible to design alternators which do not require protective gear. Much might be done, he considered, to avoid disaster by paying greater attention to mechanical details. With that opinion many engineers will agree, but it must not be forgotten that the best-designed alternators are liable to develop faults in time. In spite of every precaution which can reasonably be expected, breakdowns will sometimes occur in the insulation. The mere fact that it is possible to build alternators which can be short-circuited without harmful results does not ensure that the machine will go on working indefinitely without breaking down. No one imagines that alternator design has reached the state of finality. Further improvements will probably diminish the possibility of serious disasters happening as the result of faults between turns and other imperfections. It is, howe er, unwise to entertain the idea of running large units without protective gear. Nevertheless, we sympathise with those speakers who objected to the number of potential transformers which Mr. Kuyser's latest system involves, and who pointed to the necessity for making protective apparatus simple. Protection such as that which the "mid point" gear provides is no doubt a valuable asset, but it remains to be seen to what extent station engineers will be prepared to depart from the use of the better-known and less complicated arrangements. Possibly means will eventually be found for obtaining equally good results with a less elaborate arrangement. In any case the paper throws much light upon the subject generally. Protection does not, the author shows, merely involve the employment of arrangements for opening the main switch under dangerous conditions. It is also essential to interrupt the field circuit automatically so that the machine voltage may disappear as quickly as possible. Many whose central station experience was gained in the early days of the electrical industry maypossibly imagine that the practice of breaking of large alternators rapidly without a discharge resistance presents risk and difficulties on account of the collapse of the magnetic field. Tests have shown, however, that the field circuit of a large turbo can be broken quickly without any trouble at all, for currents set up in the core body and in the slot wedges retard the collapse of the field to an extent sufficient to limit the inductive discharge to a safe value. This, we need hardly say, is a very different state of affairs from that which existed in days gone by, when the insulation of many a machine was damaged on account of the inductive effect produced by breaking the field circuit.

Another respect in which the modern alternator differs from that of the early machines, such as the Mordey and Ferranti single-phase alternators, is in the manner in which it behaves when its field circuit is accidentally broken whilst it is running in parallel with other machines. At one time the possibility of the field circuit of a parallel operator alternator being broken was a matter which gave rise to a certain amount of anxiety; but experience indicates that the field current of modern alternators can be interrupted without exciting results. A case mentioned by Mr. Kuyser, in which the field switch of a 23,500 kilovolt-ampère machine was accidentally opened whilst it was running in parallel with other machines of approximately equal capacity, should serve to comfort those who may have had doubts as to whether anything serious is likely to happen under those conditions, for apart from the fact that a current having a value of approximately 60 per cent. of the full-load current was drawn from the line, no disturbance occurred. In all respects modern alternators behave infinitely better than those which were built in the past; but if a fault develops in a large machine which is not properly protected an enormous amount of damage may be done in a very short space of time. Even with the best forms of protective gear it is considered desirable to guard against the possibility of fire by providing dampers which will close automatically and pipes for the supply of steam to the stator.

The Institute of Transport.

No. I.

UNDER the auspices of the Institute of Transport, a London Transport Congress, under the patronage of the Duke of York and the presidency of Sir Henry Maybury, was opened on Wednesday last, and will conclude on Saturday. The first function was a reception by the President at the Hotel Metropole on Tuesday evening, but the formal opening took place on Wednesday morning at the Institution of Civil Engineers, where all the papers are being read and discussed.

The ceremony on Wednesday morning was honoured by the presence of Mr. Stanley Baldwin, the President of the Board of Trade, who said that nothing comes more closely home to the people of this country than transport. During the last half century transport had revealed the appalling conditions under which our forefathers suffered. The carriage of corn had now become a negligible quantity in the cost of that commodity. Cheap transport was a vital necessity, not only for articles of food, but for raw material. It was necessary, too, for our exports so that they might reach the markets of the world, but more important than all was its influence on the shifting about of our congested population. Transport alone would provide the necessary relief. It would enable workpeople to get well away from the workshops and factories and live in decent homes amid decent surroundings. The solution of the problems that the Congress had to consider would intensely affect the trade and population of the country. In seconding a vote of thanks, proposed by the President, to Mr. Baldwin, Sir Sam Fay said that the President of the Board of Trade possessed a greater knowledge of transport than he would admit, and he had given the Congress a lead which all would be delighted to follow.

After Mr. W. B. Worthington, President of the Institution of Civil Engineers, had expressed the pleasure of that body in having the Institute of Transport to meet in its building, Sir Henry Maybury called upon Sir Cyril R. S. Kirkpatrick to read a paper on "Recent Improvements in Transport Facilities in the Port of London," of which the following is an abstract.

TRANSPORT FACILITIES IN THE PORT OF LONDON.

In every day of the year, goods to the value of about £1,800,000 arrive in the Thames and have to be discharged and stored. They must then be transported to their point of destination by railway, road, river or canal to the markets or to the manufacturers.

No reliable estimate can be formed of the total sum expended on transport in the year within a radius of ten miles from Charing Cross, but it certainly is not less than £200,000,000. It is perhaps not too much to assert that at least 5 per cent., or, say, £10,000,000 a year could be saved in the London district by co-ordination of interests and the better use of mechanical appliances. The Port of London Authority controls 68½ miles of river, 29½ miles of dock quays, 125 miles of railway, 36 miles of roads and 300,000,000 cubic feet of shed and warehouse accommodation. It owns 42 locomotives, 245 trucks, 25 elevators for the discharge of grain, 161 barges, 818 cranes and about 74 tugs, dredgers, hoppers and launches, quite apart from minor appliances and plant belonging to private owners.

The great work of deepening and widening the navigable channels in the river is making progress, and a depth of 30ft. below low water will shortly be available from the sea to the King George V. Dock entrance. From this point the depth is gradually reduced until 14ft. at London Bridge. So far, 21,000,000 cubic yards have been removed, and to complete the programme about 25,000,000 cubic yards have still to be dealt with.

KING GEORGE V. DOCK.

Many of the older docks have been improved out of recognition, but the latest facilities are to be seen to their best advantage at the King George V. Dock. The entrance lock is 800ft. long, but it can be extended when desired by a caisson to a length of 940ft., 100ft. wide and has a depth of 41ft. 8in. below H.W.O.N.T. Vessels enter and leave at slack water round about high water and the dimensions are ample for any vessel up to the size of the Mauretania.

The dock is 4578ft. in length with a width of 710ft. at the east and 500ft. at the west end. It has a depth of 38ft. On the north side there are six berths with double storey sheds, with electrical quay cranes between the sheds and the water edge, but on the south side an entirely different and somewhat novel form of construction has been adopted. There are seven single-storey sheds, and in front of each is a reinforced concrete jetty, 520ft. long and 32ft. wide, on each of which are placed the six 3-ton electrical cranes for discharging. Between this jetty and the quay is a canal 32ft. in width for barges. The cranes can, therefore, discharge from the ship either direct into barges or on to the quay behind.

A very interesting electrical pumping plant has been constructed for the purpose of maintaining the water 3½ft. above Trinity high water level. There are three centrifugal pumps, with suctions of 70in. diameter, electrically driven by alternating-current at 6000 volts, and they pump from the river about 16½ million gallons per hour for about three hours before and three hours after high water of each tide. An interesting feature of this plant is a long-distance electrical tide gauge, by which a combined diagram is drawn of the level of the water in the river and in the docks simultaneously.

At the extreme western end of the King George V. Dock is a dry dock, 750ft. long and 100ft. in width, with a depth of 35ft. on the blocks. It can be extended, when desired, to the full length of the extended entrance lock. De-watering is effected in three hours by centrifugal pumps, electrically driven by high-tension alternating current at 6000 volts.

The equipment consists of a 25-ton crane travelling electrically for the full length of the dry dock, and reaching out 80ft., so as to lift to or from the centre of a vessel under repair. In addition, there are two 5-ton steam travelling cranes and compressed air plant for operating pneumatic ship-repairing tools.

A cargo jetty constructed of reinforced concrete 1000ft. long by 50ft. wide, was opened last year in the river at Tilbury. It has two decks. On the upper deck are two railway lines and fourteen portal electric travelling cranes of 2-tons capacity. The lower deck is used as a transit shed. The depth of water at L.W.O.S.T. is 30ft., and on the landward side a barge canal has been dredged. Discharge is made direct ex-ship, either into railway trucks or into barge or transit shed. It is proving very successful, and a great addition to the transport facilities of the port.

DOCKS, RAILWAYS AND ROADS.

All the docks, excepting the London and St. Katherine group near the Tower and the Surrey Commercial Docks on the south side, are equipped with railway facilities.

The Authority own two short passenger railways. The rails are of the flat-bottom type, weighing 75 lb. per yard. Wherever practicable, a minimum radius of 7 chains is used, so that long passenger coaches can come alongside the platforms at the back of the sheds.

The Authority's usual practice is to place three or four sets of line behind the sheds for goods, and one or two lines on the quay in front of the sheds for exceptional loads direct to or from ship, and for the purpose of removal of rubbish and ships' ashes.

In almost every case, the goods must first be discharged into the sheds for sorting and therefore for quite 90 per cent. of the rail-borne goods the platform at the back of the sheds is the proper place for loading or unloading.

The Port of London is badly equipped with road access outside the docks. But after ten years of agitation, Sir Henry Maybury is interesting the Ministry of Transport in endeavouring to remove what is, without doubt, the most crying road scandal within the whole of London.

MECHANICAL EQUIPMENT.

The Authority have adopted electric cranes with a capacity of 3 tons and a radius of 60ft., extending with a smaller lift to a radius of 65ft. The cranes travel on a gauge of 13½ft., and it is possible for railway traffic to pass under the body Most of them are equipped with horizontal luffing motion. They have given every satisfaction, but the demand for increased out-reach cannot be met without the load having to travel through a longer radius, and it is felt that the limit of practical working has been met.

With a view to overcoming this difficulty, two T-headed cranes have been built experimentally on the south side of the King George V. Dock. The cranes travel just as the others, but the T head revolves around a complete circle, and on the top is a 3-ton travelling crane of small radius. The cranes have only just been completed, and it is therefore too early to speak of the results obtained, but it is anticipated that a considerable saving in time in working will be effected.

A particular feature of the new dock is the equipment of the upper floor of the two-storey sheds on the north side. Every other bay is fitted with a 1-ton five-motion underhung crane, with a jib working at a radius of 20ft., so that it reaches about half-way into the adjoining bays on either side. These cranes travel across the shed on runways, and the jibs reach over the quay on which the 3-ton quay cranes discharge from the ship, and also over the platform and railway wagons or carts at the back.

Where this type of crane is employed, it is essential that sufficient height be provided to allow for the depth of the crane and hook and slings, so that, in addition to the increased cost due to the provision of the cranes, the sheds are also a little more expensive, but the additional cost is amply compensated for by reduced working cost.

At the Royal Albert Docks, additional up-to-date facilities have recently been provided for the discharge, sorting and storage of 646,000 carcases of mutton. The method adopted is to discharge from the ship across the quay by means of travelling mechanical conveyors on to a longitudinal band running the whole length of 1100ft. of the cold sorting floor.

One million tons of grain are discharged by the Authority annually. For this purpose they have a fleet of sixteen bucket and eight pneumatic floating elevators, and warehouses capable of storing 128,600 tons of wheat at one time.

The Authority have been experimenting with success on producing the necessary vacuum by turbo-blowers, both on fixed and floating plant, the advantages to be gained by this method being the smaller space required for the plant and the reduced working costs. It is probable this method will be adopted to a still greater extent in the future.

The Authority are now proposing to construct four more floating elevators, so as to make their equipment as perfect as possible. In addition, they have under contemplation the equipment of 2100ft. of quay at West India Dock, with travelling pneumatic appliances which will discharge the grain on to bands, from whence it will be conveyed into the existing grain warehouses at Millwall Dock, or to a new silo of 40,000 tons which is about to be built.

Considerable development has taken place in the method of

storage of hogsheads of tobacco. At the Royal Victoria Docks they are now piled five tiers high and handled entirely by quick-acting electric overhead travellers. One building, 611ft. long and of 71ft. span, has been built on this system, and holds about 8000 hogsheads.

The Port of London cannot at present boast of adequate facilities for ocean passengers. The Authority are alive to the situation, and have decided to construct a floating landing-stage at Tilbury, 1700ft. long and 80ft. wide, at which the largest vessels afloat can embark and disembark passengers. It will adjoin Tilbury Station and the Midland Railway Company will also make extensive additions and improvements to their station. The floating stage will be placed at right angles to the railway. There will be no steps, and every possible arrangement will be provided to make the embarkation and disembarkation of passengers easy and convenient. It is anticipated that this work will be commenced early next year, the present position being that a Bill is being promoted in Parliament.

In the discussion which followed, Mr. Ross Johnson asked how the swinging problem was dealt with in King George's Dock. The large jetties were a unique feature, and the novel way of dealing with baggage would be watched with interest. It was a question whether the crane or the elevator was going to be the type of the future. The elevator was quicker than the crane, and better for handling meat. Mr. Marshall Stevens was glad that the relations between the engineer and the traffic manager were closer. He thought it was essential to take the traffic for sheds direct from the docks and deal with it elsewhere. Mr. W. H. Gaunt, having two years ago criticised the Port of London Authority's methods, was delighted to say that the process of getting goods through the docks had now greatly improved. Considering the amount of traffic dealt with by barge, he was sorry more mention was not made of that subject in the paper. Sir Joseph Broadbank said that the greatest problem was that of mixed cargoes. The only solution lay overseas. If shipowners would only get to see the importance of this problem they would themselves save money. The President, on the subject of the admittedly bad road communication, said that they were building a new road, 100ft. wide, leading to Tilbury, which would be ready when the improvements there were finished.

Sir Cyril Kirkpatrick, in reply, said that from time immemorial vessels turned in the river before going into dock. There was a great deal in the question of cranes or elevators. Elevators, though, needed special treatment if they had to deal with mixed cargoes.

At 11.15 the Congress listened to a paper on "Wireless as an Aid to Transport," by Captain Riall Sankey. The reading of it by the author was not only accompanied by lantern illustrations, but by enlightening desultory remarks. The following is a summary of Captain Sankey's paper.

"WIRELESS AS AN AID TO TRANSPORT."

The first instance of wireless being used in relation to transport goes back to the year 1901, when the s. Lake Champlain was fitted with wireless telegraphy. The prime object of such an installation from the owner's point of view was at that time rather in the nature of enterprise and publicity than from motives for ensuring safety of life at sea.

Very soon it became apparent, however, that, notwithstanding the somewhat erratic nature of the communications at that date, there were possibilities of the science being utilised to a commercial end.

From the point of view of navigation, besides the well-known advantages of being able to speak other vessels or the land, there remains the subject of direction finding. This is at present carried out in one of two ways. The vessel may be fitted with direction finding apparatus and thus be enabled to obtain relative bearings of any coast wireless station or of any other ship which may happen to be transmitting, or certain selected coast stations may be fitted with direction finders, and these stations will be able to give to the ship her true bearing from the coast station if the ship asks for such a bearing and makes use of her transmitting apparatus while the bearing is being taken. The first of these two methods gives by far the greater flexibility.

In order to maintain universal communication which is so desirable for purposes of safety at sea, it is an obvious necessity that the receiving instruments of every ship should be in commission during the whole time that the ship is at sea, and in order to maintain the best possible communications amongst ships carrying only one operator, British regulations now lay down the hours during which a fully qualified telegraphist must be on duty. These hours are carefully worked out in time zones depending upon longitude. Automatic devices are provided in such ships to summon the operator to his instrument when any vessel in the neighbourhood works the device during the hours when he is off watch. An extensive trial of devices of the so-called "four-second alarm" type is now in progress.

The recently invented "wireless beam" provides an aid to navigation and an additional safeguard to the mariner. The wireless beam, about which very little information has been made public, is eminently suited for the purpose of warning ships of approaching danger and of enabling them to keep to the prescribed course. The transmitter projects a beam of wireless waves, which may be likened to a somewhat diffused searchlight beam. An automatically controlled beam sends out predetermined signals, and any ship coming into the beam hears on its wireless receiver the corresponding signal, from which it can ascertain its position.

Particulars of the short-wave wireless beam were given in a paper read before the Institution of Electrical Engineers on May 2nd, by Mr. C. S. Franklin, and reference may be made to that paper for any further particulars.

AIRCRAFT.

The next form of travel to be dealt with is aircraft. In 1914 the art was in its infancy, and the methods of keeping up communication with an aeroplane were relatively crude. Early in 1920, however, a five-valve receiver was designed and, with its birth, the results obtained exceeded all expectations. From the moment the first sample was tested on the Marconi aeroplane G-EAAB, at the Croydon Aerodrome, it was realised that good reception of telephony in the air was un *fait accompli*. In machines where it had been impossible to work at all before, owing to distortion and the interference from the magnetos, it was now possible to install a set and obtain first-class results. Where formerly it had been difficult to obtain understandable speech at short ranges, it became a common occurrence to obtain good audible speech up to ranges of 150 to 200 miles with perfect ease. On several occasions machines have been directed to the London aerodrome by means of the direction-finding facilities provided at the aerodrome station at Croydon, through thick fog and exceedingly bad weather. This fact alone illustrates the value of wireless communication with aircraft, as on each occasion these machines were filled with passengers, and in all probability, had no wireless facilities existed, bad "crashes" with possible loss of life might have been occasioned.

ROAD TRANSPORT.

Wireless does not appear to have much scope for land transport in comparison to its use at sea and in the air. Incidentally, in this country the Postmaster-General may have a great deal to say upon the matter. But whilst there appears to be little prospect of extended use of wireless in settled countries, considerable use is possible, and even probable, in unsettled countries, as, for example, in the case of an expedition in some unknown part of Africa. Wireless telephony has been applied experimentally to rail transport. The first instance was on the Lackawanna Railway, in the United States, but at the present date the results have not justified a commercial installation. Nevertheless, the experiments may conceivably end in a practical equipment in the not far distant future.

The "Cornell Special," an express train which runs between New York and Ithaca, has just been fitted with a complete radio telephone installation capable of receiving and transmitting messages over a considerable distance. In the buffet car there is a loud-speaking telephone, and receiving sets are affixed to the chair of each passenger. Referring to experiments made before the present apparatus was fixed, the *Radio Globe* says it was found that, while the train was moving through cuttings and over bridges, the signals frequently ceased entirely, while they were invariably weaker than when on the ordinary open track. This defect has not been entirely overcome, but is being corrected. In tunnels, the apparatus worked excellently; but again, when in the train sheds in Hoboken all signals stopped, due to the great quantity of steel used in the construction of the buildings.

In the discussion, Mr. Roger Smith said that in October, 1917, an aerial was fixed on a Great Western coach, running between Paddington and Bristol, and a receiving set installed in a compartment, and telegraph signals were received from Woolwich experimental station. When outside Paddington station a message was picked up from an aeroplane speaking to Broadstairs. Later, a transmitting set was fitted on a train for Fishguard, by which communication was held with Woolwich for 70 miles. This experiment proved to the satisfaction of the Signal Experimental Station that communication could probably have been kept up for the whole 260 miles. This incident had not been mentioned before as it might have led to the thought that wireless could be used in place of the fixed signals. Mr. Smith would have nothing to do with such a substitution. It would be a most improper thing that a driver should have his attention taken away from observing the road. The experiments were made for military purposes, and such means of communication should only be used for sending messages to passengers. Mr. G. H. Nash said he wished to utter a word of warning. Wave lengths were being gobbled up. Many had been taken by the services and important authorities, and he suggested that that Institute should make application for certain wave-lengths to be reserved. He thought some mention should have been made of wired wireless in the lecture. Colonel Cortez Leigh mentioned the experiments made in the early part of 1920 by the Marconi Company in conjunction with the London and North-Western Railway with wireless telephony between Euston and Crewe, a distance of 158 miles. At times the results were excellent, but at other times there was jamming, so that the scheme could not be said to have been a commercial success. He had charge of the wireless installations on the London and North-Western steamers, and said he found they gave very little trouble. The operators on the ships generally put any defect right. In his reply, Captain Sankey said the Marconi Company was working very hard at wired wireless.

Literature.

Taschenbuch der Kriegsflotten. XX. Jahrgang 1922. J. F. Lehmanns, Munich.

OF the numerous naval annuals that were published on the Continent before the war, very few survive to-day, among those that have ceased to appear being the French *Flottes de Combat*, which was so ably conducted for many years by the Marquis de Balincourt; the German *Nauticus*—a volume which, as Admiral von Tirpitz admits in his *Memoirs*, was founded by him as an instrument of propaganda for his naval policy—and the exceedingly useful Austrian *Marine Almanach*. In these circumstances we welcome the reappearance of another well-known annual, the *Taschenbuch der Kriegsflotten*, which has now resumed publication after a lapse of four years. The editorship of this little volume remains in the hands of Commander Bruno Weyer, who has evidently spared no pains to maintain the high standard of accuracy with regard to data which characterised previous editions of the work. The ship tables have been brought well up to date, no light task in view of the drastic modification which the world's navies have undergone since 1918; a number of new illustrations have been added, and special sections now deal with the war losses of the German fleet and the fate of every fighting vessel that was under the German flag when the conflict began. These latter tables are of exceptional interest, recording as they do a great many losses that were never disclosed during the war. A very large proportion of the casualties were due to mines, and the long list of destroyers, submarines, and auxiliary craft of all descriptions which met their fate from this cause constitutes a most striking tribute to the work of our mine-laying service. With regard to German submarine construction, Commander Weyer enumerates 810 boats as having been completed, laid down, or ordered from the year 1905 to the date of the Armistice. Of this total number, he states, only about half had been actually completed when hostilities ceased, the remaining half consisting of boats still in process of building or not begun.

It seems a pity that in a book of such modest dimensions so much space should be devoted to a long and uninteresting diatribe on political subjects which bear no relationship to present-day naval affairs. No less than seventy pages are taken up by a review of the war and its antecedents, the purpose of which is to show that Germany was the innocent victim of machinations inspired by perfidious England, against whom the editor obviously cherishes a prejudice that tends to obscure his judgment. Apart from this effusion, which is quite out of place in a text-book, the first post-war edition of the *Taschenbuch* contains much useful and interesting information on current naval progress, including an account of the present strength and organisation of the German fleet as reduced in accordance with the terms of the Peace Treaty. A few fresh details are given of the Russian Navy, but they do not add much to the meagre sum of knowledge which the outer world possesses on that subject. On paper the naval forces controlled by the Soviet Government still make an imposing parade, but there is good reason to believe that neglect, unskilled treatment, and deliberate sabotage have reduced the once powerful Russian fleet to a mere handful of ships the efficiency for war service of which is problematical. It appears from details given in the *Taschenbuch* that two of the vessels which Germany was completing at the end of the war were battle-cruisers of a new type. These ships, the Graf Spee and Mackensen, had a displacement of 31,000 tons, as compared with the 27,000 tons of the preceding class—Lützow and Hindenburg, which were slightly enlarged "Derfflingers." The Graf Spee and her sister were designed for 28 knots and a main armament of eight 14in. guns in place of the 12in. weapons mounted in the earlier battle-cruisers. Neither ship was completed in time to take part in the war, and both have since been broken up.

BOOKS RECEIVED.

Ministry of Public Works, Egypt. Annual Reports for 1916–1917 and 1917–1918. Cairo: Government Press. Obtainable from Government Publications Office, Ministry of Finance, Dawawin, P.O., Cairo. Price P.T. 20 each volume.

Medical Research Council. Second Annual Report of the Industrial Fatigue Research Board to September 30th, 1921 (including Analysis of Published Work). London: His Majesty's Stationery Office, Kingsway, W.C. 2. Price 1s. 6d. net.

Dock and Harbour Authorities' Directory, 1922. Being a list of members of the Dock and Harbour Authorities throughout the World and of their principal Officials. London: The Yachtsman Publishing Company, Limited. 158, Strand, W.C. 2. Price 10s. 6d. net.

Obituary.

CHARLES G. ROBERTON.

WE record with regret the death of Mr. Charles G. Roberton, of Vickers Limited, Barrow-in-Furness, which took place on Monday, May 1st, after only a week's illness.

Mr. Roberton commenced what turned out to be a very distinguished engineering career in Glasgow. About thirty-two years ago he went to Barrow-in-Furness, and, under the old Barrow Shipbuilding and Engineering Company, Limited (now Vickers Limited), occupied an important position in the marine engineering drawing-office, later becoming engineering works manager. He devoted himself with enthusiasm to the study of internal combustion engines, and was largely responsible for the development of such engines, from the petrol to the heavy oil engine type, used for propelling submarines and other Government and mercantile vessels, including some of the largest oil-driven ships afloat.

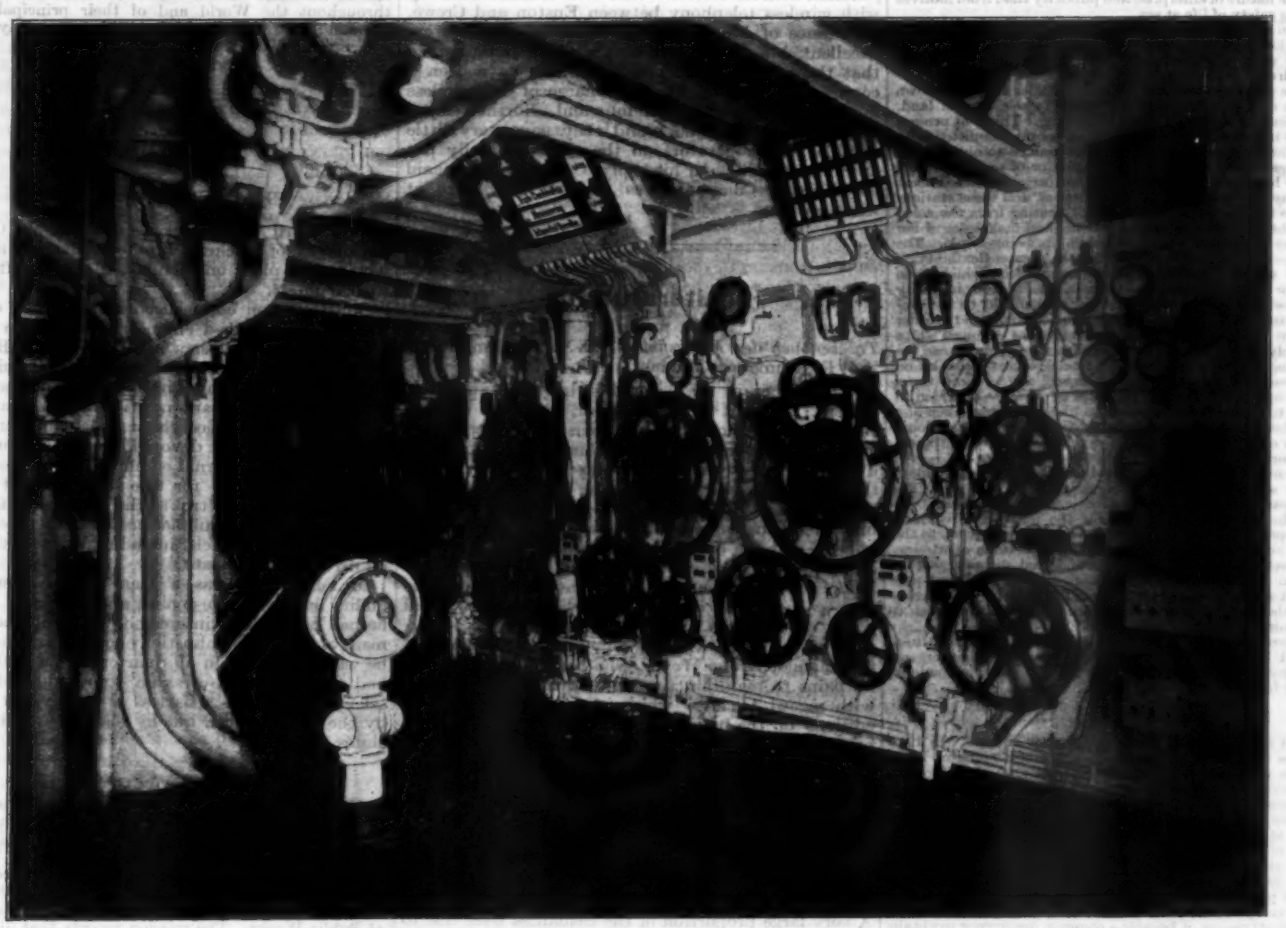
Mr. Roberton was a man of very considerable ability and inventive genius, and though of late years he had particularly interested himself in the development of internal combustion engines, on which subject he was recognised in all quarters as an authority, he had a wide and versatile knowledge of kindred scientific matters. His loss is keenly felt not only by the Vickers firm, but by his many business associates.

A SCIENTIFIC mission has recently been studying the rivers in Anatolia with regard to their suitability for transport and also their utilisation for industry. A Belgian electrical company has, it is stated, asked the Angora Government for a concession for the construction of electric power stations on the rivers, and the plans submitted are now being considered by the Angora Ministry of Public Works. The mission reports that all the roads which have recently been constructed in Asia Minor between the ports and various inland towns have been laid down with a view to their use by heavy lorries carrying goods.

THE WHITE STAR LINER MAJESTIC

(*For description see opposite page*)

TURBINE VALVE CONTROL STATION

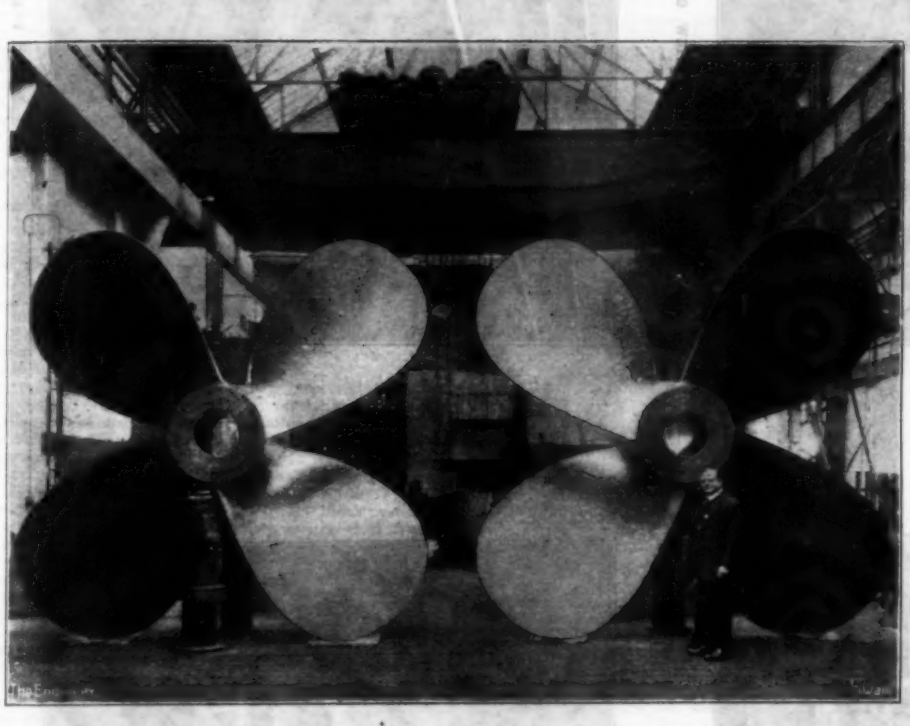


VALVE CONTROL BOARD IN CONTROL STATION

The White Star Liner Majestic.

THE White Star liner Majestic, which left Southampton on Wednesday, the 10th instant, has completed her maiden voyage successfully. We are informed that she reached the Ambrose Lightship on the morning of Tuesday, the 16th instant, at 10.30 a.m., after a voyage of 5 days 14 h. 45 min. The time taken corresponds to an average speed of 22¼ knots, which is considered to be a very good speed for the maiden voyage. In the description of the ship which was given in our issue of last week, reference was made to the control station from which all the turbine valves are controlled and operated. The two views which we reproduce on page 558 show the control station and the valve control board. As previously mentioned, the control station is situated immediately above the main engine-rooms, and in it are accommodated several auxiliary pumps in addition to the valve control gear and the by-pass controls. The main valves are hydraulically operated, and their operation is electrically indicated on a special indicator board. In addition to the main telegraphs, a loud-speaking telephone system is installed, whereby communication may be established with the various engine and boiler-rooms and the engineers' department. The control board is also furnished with the necessary pressure gauges and revolution indicators. The whole arrangement of control has been designed with a view to simplicity, from the point of view of the operator, and such simplicity is only attained by introducing the necessary mechanism to obtain the desired results. The arrangement adopted gives, we understand, in practice very satisfactory results.

In our previous description we referred to the four four-bladed propellers which drive the ship, and we are now able to state that, in addition to two propellers originally supplied by the Manganese Bronze Company, two further propellers for the completion of the ship and also two spare propellers were supplied by Messrs. J. Stone and Co., Limited, of Deptford. The four propellers now working on the ship, to the best of our knowledge, are of Messrs. Stone's make, and the illustration we reproduce shows two of them in the maker's shops at Charlton. They are made of Stone's improved manganese bronze, and the finished weight of each propeller is 15¼ tons, the diameter being 16ft. 4¾in.



TWO OF THE PROPELLERS OF THE WHITE STAR LINER MAJESTIC

The Royal Society's Conversazione.

THE predominant features among the exhibits shown at the Royal Society's Conversazione on Wednesday evening were more than usually of an anthropological or zoological interest. Nevertheless, the exhibits of a physical nature, though comparatively few in number, included some that attracted considerable attention.

At the head of the list of those items of engineering concern, we would place Professor E. G. Coker's demonstration of his investigation into the action of cutting tools by means of polarised light. It will be recalled that in his recent paper before the Institution of Mechanical Engineers, Professor Coker dealt with the action going on between the tool and work in a lathe. The apparatus shown on Wednesday evening at Burlington House reproduced the action of a milling cutter. A steel milling cutter, driven by a small motor through reducing gear, was arranged to take definite depths of cut from strips of transparent nitro-cellulose, which latter were moved continuously up to the cutter by an ordinary feed motion. The cutting action of the moving teeth was viewed in polarised light, and was shown to be somewhat complicated, as compared with that of a single planing tool, which latter could be shown in action with the same apparatus.

Sir William Bragg and Professor W. L. Bragg showed some highly interesting models of crystal structure as determined by X-ray analysis. The methods of X-ray analysis make it possible to construct models which show with great accuracy the size of the cell containing the unit of pattern of the crystal. In some simple cases the positions of the atoms in the cell are known with equal precision; in others the approximate positions can be inferred. The distance between the centres of two neighbouring atoms is generally known with much more accuracy than the radius of either. The models of organic crystals shown were based on the principle, which seems to be justified by success, that the benzene and naphthalene molecules are actual frameworks of definite dimensions. The scale of most of the models was 100,000,000 : 1.

Apparatus for recording the regularity of threads was exhibited by the British Cotton Industry Research Association. The regularity of the hardness of threads up to 200's count could be tested on this apparatus. The trace shown photographically represented the top surface of the thread under compression, and the variations were magnified 18,000 times. The thread was drawn between a pair of case-hardened shoes, which smoothed out stray fibres, and it was the apparent diameter under these conditions which was measured. This diameter is dependent on hardness of twist, fibre concentration, and fibre regularity. The variations, which are recorded photographically, are characteristic of the method of spinning.

The Cambridge and Paul Instrument Company, Limited, showed a micro-indicator for taking diagrams from high-speed engines. The indicator, designed by Mr. W. G. Collins, was shown mounted on a cylinder. The vertical movement of the end of the indicator piston deflected a strong triangular spring carrying a stylus. By an electro-magnetic device, operated by an automatic switch, this stylus was made to scratch a micro-diagram of a single complete cycle upon a disc of transparent celluloid. After taking a diagram, the disc could be rotated by a ratchet connected to a Bowden wire, so that ten separate diagrams could be taken in rapid succession. The movement of the piston is very slight, and the moving parts are light, and hence the inertia of the moving system is small and the natural period short. The actual size of the record obtained is approximately 3 mm. base (time) by 2½ mm. height (pressure). The records can be photographically enlarged, or projected for observation or tracing or read with a microscope. The indicator is claimed to be particularly suitable for indicating the engines of aeroplanes whilst in flight or of motor cars in motion.

Professor W. T. Gordon exhibited some samples of native gold recently discovered near Torquay. Gold has been recorded from several localities in Britain, but usually only in small quantities. The specimens so far obtained from Torquay are very rich, but the amount of material available is unknown, so that no idea of the value of the find can be given. The metal occurs in a crystalline condition, with dendritic habit, in the calcite cement of a fault-breccia near Hope's Nose, Torquay.

The original microphones and experimental apparatus of the late Professor David E. Hughes were shown by the Science Museum, South Kensington. This original and historical collection of apparatus was made and used by Professor Hughes in his experiments which led him from the discovery of the microphone in 1878 to the transmission and reception of wireless signals in 1879. The original model of his induction balance was shown, as well as several examples of pencil and granular microphones; also his transmitting and receiving apparatus for wireless signals. Professor Hughes exhibited his induction balance at the Royal Society's Conversazione on May 28th, 1879.

The Western Electric Company, Limited, showed a telephone transmission measuring apparatus. This instrument gives direct readings of the transmission loss, in miles of standard cable, of telephone circuits and apparatus. The instrument is so constructed as to give visual readings, eliminating the need of aural observations.

Mr. W. M. Mordey exhibited a most ingenious method which he has devised for separating magnetic from non-magnetic materials. He uses a row of laminated iron poles, which are energised by a two-phase current. When a mixture of magnetic and non-magnetic materials is laid on a tray above the magnets, the magnetic matter is projected away from the poles—the direction of travel being along the line of poles—while the non-magnetic material remains behind.

The National Physical Laboratory, among other exhibits, showed the rotascope, an apparatus by which a rotating object may be rendered continuously visible and yet appear to be at rest. The method used eliminates the necessity for illuminating the object by flashes of light by shutters or other means, as commonly used for producing a pseudo-stationary appearance, which require the object to be invisible except for a small fraction of a revolution. The principle made use of is a property of the reflection from a plane surface rotating about an axis which is parallel to its plane, and which is collinear with that of the object. The image is rendered stationary by rotating the reflecting surface at half the speed of the object. Such a method of abstracting the appearance of rotation from a rotating body suggests that the method may be useful for speed measuring, for synchronising purposes and for studying vibrations and strains in rotating objects, using, when required, subsidiary optical devices for observing parts off the axis of rotation.

ELECTRO-DEPOSITION OF IRON.

A BULLETIN just issued by the Department of Scientific and Industrial Research gives an account of an extensive research carried out by Mr. W. E. Hughes, late chief research chemist, Electro-Metallurgical Committee, Ministry of Munitions, into the electro-deposition of iron. Mr. Hughes comments on the similarity between the processes of crystalisation and deposition and gives the following practical hints.

He has, he says, been asked several times how a deposit of iron that will not be hard and brittle can be obtained. Electrolytic iron is commonly believed to be both hard and brittle, and it often is. The answer to the question just stated is contained in the following remarks. Experience shows that iron can be deposited—from the chloride bath, at any rate—with structures that vary with and depend upon the conditions of deposition. If acid be present in the solution, the structure will be fibrous; it will again be fibrous if agitation of the electrolyte or movement of the cathode be employed during the deposition. Experience also shows that a deposit from the chloride bath possessing a fibrous structure is hard and brittle. On the other hand, if no free acid is present in the solution, and if "still vat" conditions are maintained, then a deposit from the chloride bath will possess a normal structure, and experience has shown that a deposit from the chloride bath possessing that structure is soft and malleable—so much so that the iron can be flattened out under hammer blows.

Let it be assumed that a thick, smooth deposit of iron is required. Experience has shown that when the deposit is of fine and fibrous grain within, the surface is smooth; but that if the structure be of the normal type, the surface is irregular. In other words, there is a correlation between internal structure and surface features; these can be observed continuously as deposition proceeds, and hence control of the structure of a deposit maintained. To obtain a fine and fibrous structure, one must employ a solution that contains free acid, or one must agitate the electrolyte or move the cathode during deposition. To secure a thick and smooth deposit, it is necessary, in addition, to maintain approximately constant the concentration of metal in the solution; for concentration is always an important, Mr. Hughes believes it to be the dominant, factor determining the structure of a deposit, the other factors affecting the structure, if not perhaps wholly, then, at any rate, especially, in consequence of their effect upon the concentration. To obtain a thick, smooth deposit of iron, one must therefore use a bath containing free acid or must agitate the electrolyte or move the cathode during the deposition, and one must, in addition, see to it that the metal concentration of the bath does not become appreciably diminished.

LONG DISTANCE POWER-OPERATED FACING POINTS AT ASHINGTON COLLIERY

THE WESTINGHOUSE BRAKE AND SAXBY SIGNAL COMPANY, LIMITED, LONDON, ENGINEERS

(*For description see opposite page*)

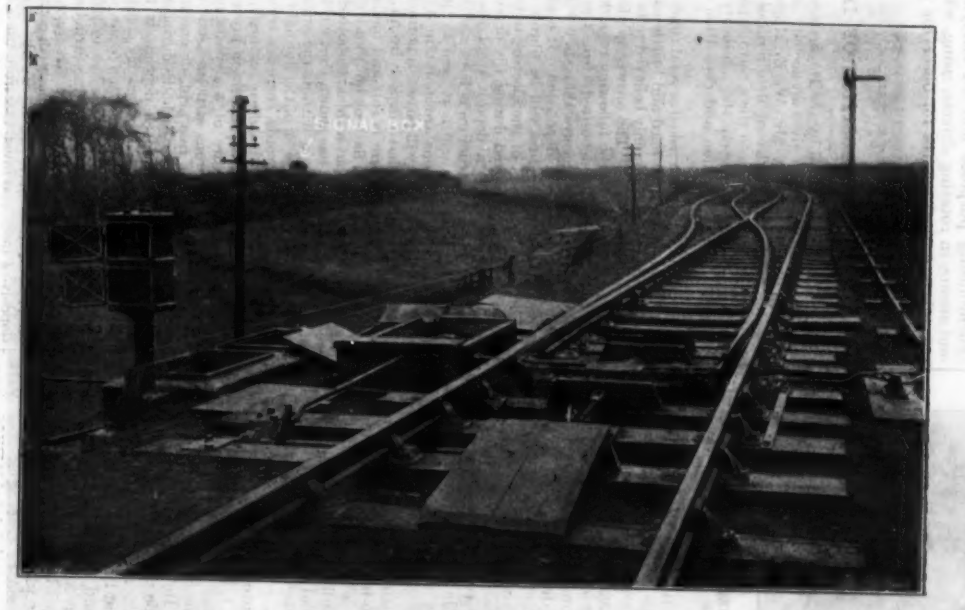


FIG. 1—GENERAL VIEW OF JUNCTION

FIG. 2—VIEW OF FACING POINTS FROM THE FRONT

FIG. 3—VIEW OF FACING POINTS FROM THE REAR

FIG. 4—DERAILER LIFTED FROM THE RAIL

Long Distance Operation of Facing Points on Railways.

FACING points, naturally, are a source of danger on a railway, as if the switches are not in their proper position—one close against the rail and the other open the requisite distance—there is a possibility of derailment. Consequently, in order that the operating rods shall be able to do their work unfailingly—to move the points accurately and to bolt them in their new position—the maximum distance facing points may be situated from the signal-box has been prescribed by the Board of Trade. The limit originally was 120 yards, but the rollers for supporting the rods have been brought closer together, the bolting arrangements have been improved, and detectors through which the wires to the signals are led have been introduced, and the distance has gradually been increased, until now the Ministry of Transport will accept positions 350 yards distant for manually operated points, and for power-operated points there is now no limit.

Power-operated signalling has many other advantages than that of unlimited distance. The signal-box may, owing to the absence of rodding or wires for point and signal movements, be placed in positions impracticable under ordinary conditions; the accurate action of the point and signal lever is guaranteed; by selective arrangements one lever can operate any one of several signals; the reduced size of the levers and their distance apart permits of smaller signal-boxes. Other benefits could be named, but it has to be acknowledged that power signalling is costly to install and to maintain, and railway companies, at the present time, may be justified, notwithstanding the economies that would at once be forthcoming, in hesitating to spend capital on it.

Now, however, it is possible to obtain the benefits of power-worked points without going to the expense of a power plant. There is an installation in the North of England which we recently had an opportunity of inspecting in which facing points, 500 yards distant, are actuated by primary batteries. It is true that the installation is on a line belonging to a colliery company, but non-paying passengers are carried on this railway, and we are able, after our inspection, to testify that the equipment complies to the full with the requirements of the Ministry of Transport.

THE ASHINGTON COLLIERY COMPANY'S RAILWAYS.

It will come as a surprise to many to know that there are in the North of England hundreds of miles of railways, owned and worked by colliery companies, over which trains conveying passengers are run. They are not fare-paying passengers; all are workmen, going to and from their homes, and others connected directly or indirectly with the colliery company. The railways, not being open to public traffic, are not, therefore, subject to the Ministry of Transport.

The particular railway we recently inspected belongs to the Ashington Colliery Company, of Ashington, near Morpeth. There are 3.65 miles of double line, 3 miles of single line, 25.82 miles of branch road and sidings, 23 railway carriages, 340 colliery wagons, 11 locomotives of 4ft. 8½in. gauge, and 2 of 2ft. gauge, and the mileage of the workmen's trains is 250 per day. The lines over which these trains run are protected by the block system, and usually any level crossing gates are worked from signal-boxes and protected by signals.

Before going further, we would quote a remark made at the Engineering Conference last summer with reference to this particular colliery company. When, on June 29th, Mr. Alexander Ross's paper on "The Structural Outlines of our Home Railways" was under discussion, Sir Vincent Raven said that the North-Eastern Railway had built 40-ton wagons, but the difficulty was to find a colliery which would be able to deal with that class of wagon under its screens. There was a colliery at Ashington, dealing with 1,000,000 tons yearly, which raised its six screens some years ago, and the North-Eastern took all that coal in 40-ton wagons.

The colliery company's line between Ashington No. 1 and Ashington No. 2 boxes, a distance of 2750 yards, has recently been converted from single to double line. At No. 2 box there is a junction, the double line being continued to Linton and a single line leading off to the right for Ellington. The junction is laid in accordance with standard practice; there is a double line junction, and the two lines converge on the branch into a single-line junction. This junction, which is 500 yards from the signal-box, is worked electrically therefrom. As will be seen from Fig. 1, page 560, there is, in addition to the distance, a curvature which would have prevented a satisfactory mechanical operation.

In the signal-box is the usual locking frame—see the accompanying engraving—wherein lever No. 7 is allocated to operate the points in question. To the underside of the timber, in the lower part of the signal-box, that carries the base of the locking frame, is a six-way contact box, on the right side of which is a crank coupled by a rod to No. 7 lever. At the signal-box is a 10-volt battery of sixteen Edison caustic soda cells connected to one side of the circuit breaker. The lever, as in the standard power-operated locking frame, cannot be pulled fully over, nor put to normal, at one stroke; only about two-thirds of the movement can be made at first. In the illustration the lever is seen as it stands when the points are to be moved from their normal to their reverse position. This movement, through the circuit breaker, joins up the 10-volt battery, and current is sent to a track relay at the points which ensures that the points are not fouled, and thence to a polarised point control relay which joins up the battery at the points, and they are unlocked, moved over and re-locked. When this is done, current from the battery at the points flows through another wire and takes a lock out of the lever, allowing its movement to be completed. Over the lever, and immediately to the right of the block instrument, is an instrument, on the same battery as that just mentioned, with three indications: Normal, Reverse, Wrong. These correspond to the position of the points, and are a constant indication. The "Wrong" sign appears as the points are moving, or if they should be accidentally or wilfully misplaced. The small indicator further to the right and next to the bell shows the condition of the track circuit at the points which extends from the home signal for coming off the single line to the fouling point on both the double lines. This indicator is incidentally useful to tell the signalman when the tail of a departing train has passed on to the single line and when an arriving train is clear inside the up line.

In the pit on the extreme left of Fig. 1, seen with the two covers removed, is a 20-volt battery of thirty-two Edison caustic soda cells, in front of which is a relay box containing, in the upper part, the polarised point control relay and, in the lower, the track relay, which, as has been said, is part of the track circuit. Figs 2 and 3 are closer views of the point mechanism. The machine itself is similar to those at Baker-street mentioned by Mr. Willox in his paper, "All-electric Automatic Power Signalling on the Metropolitan Railway," read at the Institution of Civil Engineers on March 21st. Therein it was said: "These point machines have been in use since January, 1913, and have been so scientifically and strongly constructed that the pinions on the motors and in the various parts of the machine are still practically as good as when originally put in, and no failures have arisen, although several of them have shifted the points over 500,000 times."

The machine consists of an electric motor, driving, through a chain of gears, a drum having cam paths in which are two rollers. One roller is attached to the crank in the foreground on the left in Fig. 2 and on the right in Fig. 3. This crank works a shaft whereby the plunger in the centre of the "four-foot" unbolts and bolts the stretcher rod. The stretcher rod is divided at the place where the bolt enters, so that each switch has its own slot and the plunger therefore enters both. The other roller is attached to a crank coupled to this operating rod, seen passing under the left rail in Fig. 2, and attached to the

INTERIOR OF SIGNAL BOX

points. To this rod is also coupled the rodding, seen on the extreme right in the engraving on this page, leading to a derailer—Fig. 4—fixed near the signal. These derailers were described and illustrated in THE ENGINEER of May 27th, 1921.

In front of the plunger is a switch box containing circuit breakers, operated by each switch blade and the plunger. There is another switch box at the derailer. The latter is seen, with its cover off, on the right in Fig. 4. Through these flows the current from the points to the check locks on No. 7 lever and to the indicator above that lever.

Owing to the lines in the vicinity of the points being track-circuited, the points are held when any wheels are in their vicinity. There is, therefore, no locking bar provided; only the plunger is installed. About 3 ampères are required to start the machine, but after the movement has begun 2 ampères are sufficient. The time of operation is about 18 seconds. The points are used about eighty times a day.

Our thanks are due to the Ashington Colliery Company, and in particular to Mr. E. O. Southern, the agent; Mr. J. J. Hall, the sub-agent; and Mr. J. Eskdale, the engineer; and to the Westinghouse Brake and Saxby Signal Company, Limited, 82, York-road, N. 1, which supplied and fixed the installation, for an opportunity to see the points in work. To the latter we are further indebted for the photographs from which our illustrations have been prepared.

THE INSTITUTION OF CIVIL ENGINEERS.—The annual dinner of the Institution of Civil Engineers was served in the Hall of the Institution on Thursday, May 11th, the President, Mr. W. B. Worthington, occupying the chair. The health of "The Imperial Forces" was proposed in a felicitous speech by Sir John Aspinall and was acknowledged by Lord Lee of Fareham, First Lord of the Admiralty, who took the opportunity to traverse certain statements made by Sir Eric Geddes with regard to the reduction of naval expenditure; and by Lieut.-Colonel Sir Robert Sanders, Under Secretary of State for War, who spoke in the unavoidable absence of Sir Laming Worthington Evans, Secretary of State for War. Sir Maurice Fitzmaurice then proposed the toast of "The Guests," which was acknowledged by Lord Desborough. The last toast, that of "The Institution," was given by Mr. H. A. L. Fisher, President of the Board of Education, and the response was made by the President.

Books of Reference.

The Empire Municipal Directory and Year Book—now in its fortieth edition—contains a very large amount of information; so large, in fact, that it is quite impossible to refer to it all in a short note such as the present. First of all, there is a directory of local authorities, with their officials, populations, &c., not only of this country, but in the overseas Dominions, Dependencies, &c. Then there is a section devoted to "Road Construction and Maintenance," which is followed by others on "Engineering and Building Construction," "Plain and Reinforced Concrete and Cement," "Lighting, Heating and Ventilation," "Municipalities and Motors," "Water Supply, Purification and Softening," "Sewerage and Sewage Disposal," "Health Officials and Sanitation," "Municipal and Public Health Legislation," "Public Cleansing and Waste Utilisation," "Fire Prevention," and "Housing and Town Planning," all of which contain much useful and practical data, and many of which contain brief histories for the past year of the subjects with which they deal. Finally, there are lists of municipal engineering, public health and scientific societies; a buyer's guide; a list of books dealing with municipal, sanitary and general engineering, &c.; and a three day to a page diary. The whole forms a book of reference which should appeal particularly to municipal officers of every branch, and which we, ourselves, have from time to time found extremely useful. The volume is published by the Sanitary Publishing Company, 8, Breams-buildings, E.C. 4, price 10s. 6d. net.

The Journal of Commerce Annual Review for 1921. Liverpool: The Journal of Commerce. Price 3s., by post 3s. 9d.—In this volume Mr. Charles Birchall presents a comprehensive review of the year's shipping and kindred matters, many eminent authorities having contributed articles. Dealing with the "Trend of Ship Design," Professor T. B. Abell points out that naval architects appreciate the fact that lower production costs are essential, and many instances may be seen of their efforts to attain it in ship construction during the past year. Marine engineering in 1921 and the merits of the electric drive as applied to steamships is dealt with in an exhaustive manner by Mr. Hamilton Gibson. Ship repairing has become a highly specialised trade upon which Mr. L. E. Smith, chairman of Smith's Dock Company, Limited, writes with authority. Besides providing employment for a great number of men, many instances are recorded where great ingenuity has been needed to effect repairs. We may add that the review is not confined to Britain, and many interesting details of what other countries have done are embodied. Besides such special articles as these, a great many pages are devoted to war records of British merchant ships.

The Railway Year Book for 1922. London: The Railway Publishing Company, Limited, 33, Tothill-street, S.W. 1.—This annual volume reaches its twenty-fifth year of publication with the current issue. So much detailed information is compressed between the covers that the publishers may well use the sub-title, "The Whitaker of the Railway World." In view of the great changes which our railways are undergoing at the present time, as required by the Railways Act, 1921, the new volume is very welcome as, besides a complete summary of the provisions of the Act, many details in connection with amalgamations are given, and a new map of the London and North-Western Railway appears. A review of the progress in electric traction in Great Britain is given for the first time. Much new material has been added to this year's volume, and it is remarkable that in view of its 400 pages the price still remains at 5s. net.

Self's Directory of Registered Telegraphic Addresses, 1922. London: Business Dictionaries, Limited, 166, Fleet-street, E.C. 4. Price 45s. net.—We have received a copy of the above-mentioned directory, which now attains its thirty-seventh year of publication. At the present time it covers over three thousand pages. The inland abbreviated addresses have been obtained from official lists supplied by the authority of his Majesty's Postmaster-General. Over 100,000 firms consider it necessary to register a telegraphic address for business purposes. In the classified trades section nearly 130,000 names of firms are arranged in order of trade under some 3500 headings, with index to trades. There is a "Too late" list in the supplementary edition, and we may say that this edition has been revised right up to the date of publication.

The Post Office London Directory, 1922. London: Kelly's Directories, Limited, 186, Strand, W.C. 2. Price 55s. net.—The 123rd annual edition of this invaluable directory has been received, and we observe that its scope has been extended by the inclusion of Stratford, Plaistow, Canning Town and Silvertown. As these places cover a large amount of ground, much new work has been entailed. Telegraphic and telephone addresses and numbers, not only of business firms, but of private individuals, are now included. Despite these changes, the whole issue is in one volume, and not in three, as in recent years.

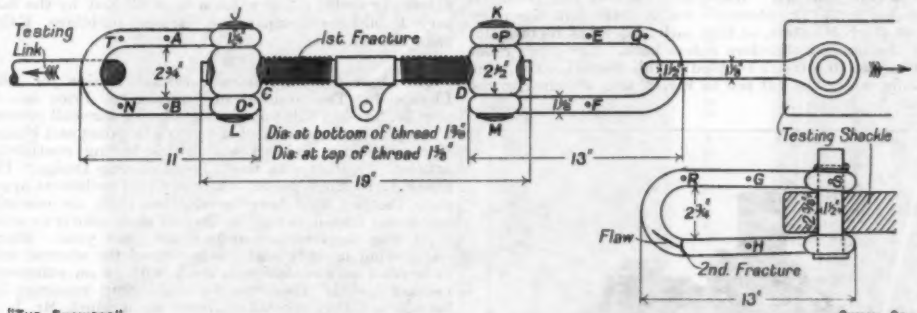
The Syren and Shipping International Mercantile Diary and Year Book, 1922. London: The Syren and Shipping, Limited, 93, Leadenhall-street, E.C. 3. Price 7s. 6d. net.—The sixth annual edition of this year book is to hand. It contains important information for exporters, merchants and shippers—in fact, anyone who wishes to do business overseas. A foreign exchange conversion table which covers all currencies is included.

The Ship Compendium and Year Book, 1922. London: Compendiums, Limited, 18, Old Compton-street, Soho-square, W. 1. Price £2 2s. net.—This volume is a classified directory catalogue, dealing exclusively with international ship construction, equipment, ownership and maintenance. A vast amount of information has been collected and carefully classified. The book is printed in clear type on good paper and bound in red boards. Several coloured maps are included.

Nickel-Chrome Steel Railway Couplings.

IT is common knowledge that, as in flying, so also in steel manufacture, the war provided so peremptory a stimulus that the progress made during the period far surpassed anything that might have been forecast for an equivalent period of peace-time development. It has not always been found possible to adapt the knowledge acquired during the war to peace-time purposes, but full use of it would appear to have been made in the manufacture and treatment of nickel-chrome steel as applied to railway screw couplings. It is now some years since the gradual increase in the weights of trains and the capacity of wagons led certain companies, more particularly in India, to seek a substitute for Yorkshire iron or straight-carbon steel couplings with the eventual selection of nickel-chrome steel for these important components. This type of steel was very largely used during the war, and a wide experience was gathered as to the best heat treatment to ensure uniformity and soundness. Cammell Laird and Co., Limited, have applied this knowledge to screw couplings with, it is claimed, most successful results. We

Results of Pulling Tests Applied to a Screw Coupling Weighing (Complete) 59 lb., Received February 14th, 1922, from Cammell Laird and Co., Limited, Sheffield.



Gauge points were marked on the coupling at AB, CD, EF, GH, JK, LM, NO, PQ, RS, and ST, and the movement of these points was noted as the load was gradually increased. After certain loads had been applied the pressure was released and any permanent set noted. After the screw had broken the loose shackle was tested separately.

Position of gauge points.		Movement and set, in inches. Load in tons. 1	18	30	35	40	50	60	70	80	85	Position of fracture.	Max. load. Tons.	Max. load. Tons per sq. in. at bottom of thread.	Appearance of fracture.
AB = 4in.	Closing in ..	Zero	None	.02	.02	.03	.07	.09	.12	.19	.21	(1)			
	Set	—	—	—	—	—	None	.03	.06	.11	.13				
CD = 12in.	Extension ..	Zero	—	—	—	None	.02	.03	.03	.05	.05				
	Set	—	—	—	—	—	—	—	—	—	None				
EF = 4in.	Closing in ..	Zero	None	.03	.04	.06	.10	.12	.19	.26	.30	Screw	114.22	76.9	Fibrous with a silky edge
	Set	—	—	—	—	—	None	.03	.10	.20	.24				
GH = 4in.	Closing in ..	Zero	.03	.06	.07	.10	.12	.16	.22	.31	.35				
	Set	—	—	—	—	None	.02	.06	.12	.22	.27				
JK = 15in.	Opening out	Zero	.02	.03	.04	.05	.05	.08	.09	.11	.12				
	Set	—	—	—	—	—	—	—	—	—	None				
LM = 15in.	Opening out	Zero	None	.02	.03	.03	.04	.06	.08	.10	.11	(2)			
	Set	—	—	—	—	—	—	—	—	—	None				
NO = 8in.	Extension ..	Zero	—	—	—	None	.02	.03	.04	.06	.07				
	Set	—	—	—	—	—	—	—	None	.02	.04	Loose shackle GH	122.60	—	Ditto
PQ = 10in.	Extension ..	Zero	—	—	—	None	.02	.02	.07	.10	.11				
	Set	—	—	—	—	—	—	None	.03	.07	.08				
RS = 10in.	Extension ..	Zero	—	—	—	None	.02	.03	.04	.07	.08				
	Set	—	—	—	—	—	—	None	.04	.05	.05				
ST = 42in.	Extension ..	Zero	.06	.11	.13	.17	.19	.25	.38	.52	.60				
	Set	—	—	—	—	—	None	.05	.20	.28	.37				

print above the leading particulars taken from a test sheet showing the results obtained at the Sheffield Testing Works on a coupling manufactured by this firm, selected at random from a batch put forward for inspection. This test, we are informed, is characteristic of all the tests obtained in connection with a contract for several thousand couplings which the firm is now completing, and, it is claimed, should result in all doubts regarding the consistency of the steel being set at rest.

The test is a destruction test, the specified minimum load being 100 tons. It is instructive to note, it is pointed out, that in addition to being able to withstand this degree of tension, the nickel-chrome coupling, apart from actual fracture, will carry about twice the tonnage of straight-carbon steel couplings without permanent distortion, the elastic limit being 85 per cent. of the ultimate strength. The weight is also 10 lb. less than that of the carbon steel couplings.

The methods adopted by Cammell Laird and Co. are claimed to reduce to a minimum the risk of injury to the steel by overheating at any stage in the course of manufacture. The essential operation of heat treatment is carried out under the most careful pyrometric control.

The Development of Electricity in Switzerland.

(From our own Correspondent.)

GENEVA, May 1st.

A LEADING electrical engineer, who has been studying the water power of Switzerland, considers that when all the country's hydraulic forces have been developed for electric purposes, she will have no need of either coal or any other fuel. The latest and most accurate estimate of the amount of water power available in Switzerland is that of the Government Water Utilisation Office—4,000,000 horse-power, of which at present only about 20 per cent. is utilised. Switzerland herself, however, could not utilise 4,000,000 horse-power, and therefore, were all her water power developed, perhaps as much as 50 per cent. would be available for export.

Hitherto she has been dependent for her coal upon her neighbours, particularly upon Germany and France, but now she expects to be able to sell electric power to both these countries and also to Italy more cheaply than they can produce it themselves. Very wisely the Government has laid down a rule that no electric power may be exported from the country without its permission, for it regards water power as a national asset.

Dr. Bertschinger, a well-known Swiss engineer, who has investigated the question of the development of his country's water power, estimates that the amount of electricity required at present is enormous, not only for railways, which are steadily being electrified, but for factories, engineering works, and agriculture. And this not in Switzerland alone, but in all the surrounding countries. Thus the chief industries of the Black Forest are at present mainly dependent on Switzerland for electric power, especially on the Power Transference Works of Rheinfelden. To make the Black Forest industries more independent of Swiss electric power, the Germans have been for some time planning to enlarge the Triberg electric works in this district, which project, it is estimated, will cost 150,000,000 marks and take about three years to execute. When it is accomplished, however, the Black Forest district expects to be no longer dependent on foreign electric current, and even to have current of its own available for export.

Already, although so small a proportion of Swiss electric power is being utilised, there is a veritable network in the country of high-tension transference cables conveying electric force sometimes over mountain passes of 8000ft. altitude, from one part of Switzerland to another. Thus one such high-tension cable is carried over the St. Gothard Pass (6936ft. altitude), and another over the Gemmi Pass (7640ft. altitude). The latter line operates at a pressure of 55,000 volts and conveys 12,000 horse-power from the aluminium industry works at Neuhausen to the Bernese power station. The city of Zürich, with about 200,000 population, calculates that it will need 32,000,000 kilowatt-hours by 1925, and by 1935 probably 55,000,000 or more. Already not only are all textile works in Zürich using nothing but electric power, but most bakeries use it, and the household consumption is very considerable. Electric cooking stoves and heating apparatus are common, and the makers of electric heating stoves declare that within the next five years it will not be necessary to build houses with chimneys. In German Switzerland a great deal of electric agricultural machinery is used for threshing and winnowing, for ploughing, harrowing, and even sowing, as well as for distributing manure and for unloading hay from carts into barns. The wealthier farmers often have their own machinery, and the smaller use what are known as co-operative machines belonging to a village or commune.

The demand for electric energy from other European countries may be inferred from the fact that one Swiss company for transmitting and distributing electric power abroad has asked the Government for a temporary permit to export during the summer of 1922 6000 kilowatts of electric power for the electric works at Waldshut, Germany. Another company asked leave to export 16,000 kilowatts to France, to be used for coal mining purposes and by the Lorraine Electricity Company at Nancy. Altogether there were eighteen different permits to export electricity abroad granted by the Swiss Government last year, and the number is likely steadily to increase.

What Switzerland requires for the development of resources which are of international and not mere local importance is, of course, credit. German firms still give a year and even two years' credit. But they are in a better position to do so than are British firms, because they are, so to speak, on the spot here, and can easily ascertain the details about security. The item "coal" in the Swiss Federal Railway estimates has already been reduced by several millions, and, again to quote a distinguished Swiss electrical engineer, "it may pay in future to mine for coal for the purpose of blast-furnaces, but so far as locomotive power and household heating are concerned, coal will have had its day."

Switzerland, in short, as her best engineers plainly perceive, must now take into consideration Central European policy in general as regards the utilisation of her water power. There are questions, prominent among which is that of water power, which cannot be limited by a continental country's frontiers, but must be settled by it with adjacent countries, all taking one another's conditions and necessities into account. Not only is Switzerland, it is estimated, rich enough in water power to be able to allow a certain amount of it to be permanently exported, but she is the starting point of the regulation of the Rhine, the Rhone, and of the river Ticino, and the regulation system is very important to her neighbour states, for foreign countries want equalisation between high water and low water in their rivers and lakes, and whether they can have it or not depends on Switzerland's collaboration. Only in the lakes on Switzerland's frontiers is it possible to store up water. If, however, Switzerland is to have the navigable waterways to the sea which she so greatly desires, she is dependent on the goodwill of her neighbours and their Governments, and on Government and private undertakings generally. In return for being allowed a voice in deciding questions of the navigation of waterways forming Switzerland's sole access to the sea, the Swiss, it is argued, should be ready to endeavour to bring about in their country such an equalisation of water power as foreign Powers may desire. But then Swiss power stations on frontier rivers and in frontier districts would have to be under special protection, internationally determined and internationally guaranteed.

AUSTRALIAN BROWN COAL.

ACCORDING to the second annual report of the State Electricity Commission for Victoria, a scheme for utilising the brown coal deposits at Morwell for the generation of electricity and for fuel purposes is progressing rapidly and satisfactorily under the direction of the Commission. The township of Morwell is 5 miles from the site of the new power-house, which is to be erected as part of this scheme; consequently, to avoid confusion, a new name, Yallourn, has been found for the power-house, and the new township which is springing up around it. The principal contracts in connection with the scheme have now been let. The power-house will contain five 12,500-kilowatt turbo-generators. The voltage of transmission will be 120,000.

As the power requirements of the metropolitan area are increasing so rapidly, and the Yallourn power-house will not be ready for two or three years, it was decided to push on as rapidly as possible with a new power-house in Melbourne. It is to be known as the Newport B Station, and to be adapted to be linked up with the bulk supply at a later date. The initial installation at this station will consist of one 14,000-kilowatt turbo-generator, with a second generator of similar size as a stand-by. It is hoped that this station will be in operation by May, 1923.

As regards fuel, the Commission anticipates that it will be in a position in June, 1922, to supply to the public raw brown coal from Morwell. An inclined approach to the surface of the coal is being constructed and two "Bucyrus" shovels with a capacity of 2¼ and 3½ cubic yards respectively will be used for excavating both the overburden and the coal. The landed cost of the two shovels will be about £58,000. From the open cut the coal will be transported to a crushing and screening plant by a system of endless rope haulages. In view of the encouraging results obtained in other parts of the world from the use of pulverised black coal as a fuel, the Commission intends to install an experimental plant for the production of brown coal in powdered form and to investigate its suitability for locomotives and stationary boilers.

A briquetting plant, having an initial capacity of 300 tons per day, or about 90,000 tons per annum, and containing five presses, has been ordered and will shortly arrive. Samples of Morwell brown coal have been briquetted in Europe with very satisfactory results.

CONTRACTS.—Ferranti Limited has received an order for and is constructing seven 4000 kVA single-phase transformers for the Mangahao—New Zealand—hydro-electric scheme. The transformers are for use in banks of three, forming two three-phase groups, each 12,000 kVA, 110,000/10,500 volts, 50 periods. They are of the core type, oil immersed with forced oil circulation.

ENGINEERS' SHOW ROOMS.—There has just been opened in a turning off Vauxhall Bridge-road, what is, we believe, the most comprehensive show room of engineering products in the country. It has been organised by the Birmingham Small Arms Company, Limited, with the object of displaying representative examples of the large variety of manufactures produced by the parent company and the allied firms, including the Daimler Company, Burton, Griffiths and Co., and William Jessop and Sons. The range of goods on view is far too great to be given in detail here, but it may be gauged to some extent from the fact that in the tools department there is practically everything required in a workshop, from hack saw blades up to elaborate milling cutters, fair-sized lathes, milling and drilling machines. A section is devoted to small arms and a whole floor to cycles. On the ground floor there is a show room for Daimler motor cars, and another for heavy machine tools, such as large milling machines and grinders; while the basement also is devoted to machine tools of both British and American manufacture. There is a 10-ton hoist connecting the basement with the ground floor, and we should imagine that some of the machines on view must tax its capacity to the utmost. Unfortunately, on account of the proximity of a hospital, it is not permissible to show the machines in motion, but the exhibition should go a long way towards attracting the attention of engineers to the utility of tools and appliances with which they might not otherwise become familiar. The building, which has five floors, giving an available area of 30,000 square feet, and is known as Chapter-street House, is just behind the show rooms of Burton, Griffiths and Co., in Chapter-street, and is only a short tram ride from Victoria Station.

Protective Apparatus for Turbo-Generators.*

THE development of protective devices for alternators has probably been somewhat as follows:—(1) Fuses, operating on overload only; (2) circuit breakers, operating on overload only; (3) circuit breakers, operating on overload and reverse power; (4) circuit breakers, operating on generator fault only and not on overload (balanced protection); (5) circuit breakers, and field switch operating on generator fault only and not on overload (balanced protection).

The last-named is the only protective system in which the generator field has been "killed" wherever the main circuit breaker has opened automatically, and marks a great advance, especially in the case of enclosed machines.

The following are the main requirements of modern electrical generator protective gear. The gear should operate on all possible faults in the generator or in the cables between generators and bus-bars, but should be inoperative for faults and short circuits external to generator and cables. The gear should operate the main circuit breaker, interrupt the field current and reduce the generator voltage to a small value in the shortest possible time. Further, it should not introduce in the system new weak points which are likely to increase the risk of breakdowns or cause unnecessary shut-downs.

The system most commonly used is the Merz-Price balanced protective gear. In this system two current transformers are inserted in each of the phase windings, one transformer being located at the terminals or the switchboard and the other at the star point. The transformer secondaries belonging to each phase are interconnected by means of pilot wires, and the tripping relay is connected between the pilot wires. The relay closes the tripping circuit for the main breaker and the field switch. The star point of the system must be earthed. It will be seen that the gear will trip for a fault to earth in the generator leads, or a fault between phases.

In the case of a fault between different turns of the same phase winding, the fault currents are purely internal, and will not cause unbalancing of the currents in the phase terminals. No protection is therefore obtained for such faults until they develop into an earth or into a short-circuit between phases. This constitutes the most serious defect in the Merz-Price system. Another limitation of the Merz-Price gear is in connection with the current transformers and the earthing resistance.

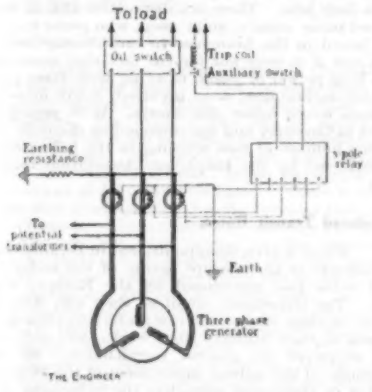


Fig. 1—Self-Balancing Protective Gear

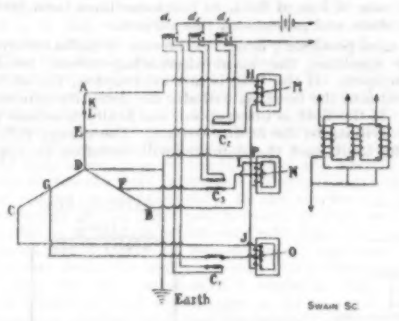


Fig. 2—Mid-point Protective Gear

SELF-BALANCING SYSTEM.

This system has recently been proposed by Mr. J. R. Beard to overcome some of the above-mentioned defects in the Merz-Price system, and has been adopted in several power stations. Fig. 1 shows the arrangement. The two ends of the phase windings are carried through the same core, and a secondary winding on this core is connected to the relay. The advantage of this arrangement is that the current balance is obtained by means of a single-current transformer, thus eliminating the difficulties in obtaining a perfect balance mentioned above in connection with the Merz-Price system.

The relays can be set to operate at their minimum current, and even if a relatively high earthing resistance is used, the gear will operate on faults to earth, although they may occur near the star point of the generator. The limitation to this device is the fact that in order to prevent complication of the gear, a bus-bar type current transformer is used to obtain the balance. With such a transformer, the sensitivity is limited unless the out-of-balance current exceeds approximately 20 ampères.

MID-POINT PROTECTIVE GEAR.

A new proposal, by the author and Mr. J. R. Beard, for a protective gear which will operate for all possible faults, including faults between turns, is illustrated in Fig. 2. The protected generator A B C D is provided with tappings E F G from the mid-point of each phase. Reactance coils, or potential transformers, are connected in parallel with each phase, and also provided with mid-point tappings M N O. The mid-point of the generator and that of the reactance coils are connected together. Current transformers are inserted in the mid-point connections and the secondaries of these transformers are connected to the relays.

When the machine is in normal operation, the interconnected points of generator and resistance are at the same potential and no current will flow in the mid-point connections. If a fault occurs between turns—for example, between points K and L, Fig. 2—the number of active turns between points A and E will be reduced and at the same time the flux will be weakened by the demagnetising action of the fault currents. Both actions will reduce the voltage between A and E, and, to a smaller extent, the voltage in E D. The voltages in A E and D E will therefore be different, whereas the voltage of H M and M P will remain equal, being generated by the same flux. A current will therefore flow in the mid-point connection E M. The voltage and current induced in the mid-point connection is used to operate a tripping relay, by means of a transformer.

The unbalancing of the voltages in the phase halves or the shifting of the mid-point in the generator phase winding occurs not only on a fault between turns, but also when a fault occurs to earth or between phases. For example, a fault to earth at K—Fig. 2—will circulate a large current in K D, which will reduce the voltage of D E to a greater extent than the voltage of A E. The same will be the case for a fault from K to any point of the other two phases. The system will therefore deal with any fault in the generator winding, including faults between turns, and will give more complete protection than has hitherto been obtainable.

It will be seen that a fault outside the generator, for instance, in the cables leading from the generator, will not cause unbalancing, and the generator leads would therefore not be protected. To include the leads in the protection, the cables can be provided with a conducting shield surrounding the central core and insulated for half the phase voltage from the core and from the armour. This shield is connected to the mid-point at the generator end. The reactance coils in this case are located at the switchboard, and their mid-points connected to the shield. It will be seen that a fault from one of the cores to earth must be preceded by a fault from the core to the shield which forms the mid-point connection, and such a fault will operate the gear.

The generator winding has in this system to be provided with three tappings insulated for 50 per cent. of the generator voltage, and three terminals for the mid-point connections, which carry normally no current and can be of very small section. It is not necessary to bring out the six phase leads as in other systems. The star point can be made in the stator winding and the generator therefore requires only four main leads and three small pilot leads. Instead of installing separate reactance coils, the potential transformers which are usually required in connection with the voltmeters and wattmeters can be provided with tappings and used for the protective gear. A convenient arrangement is shown in Fig. 3. In this arrangement two potential transformers are required per phase, the secondaries of which transformers are connected in opposition in series with the relay. Special secondary windings are provided for the instruments. As regards the sensitivity and the operation for faults to earth near the star point, this gear is similar to the self-balancing gear in so far as no operation is to be feared for heavy overloads and the relays can be set to their maximum sensitivity. The limitation for dealing with these faults is therefore determined only by the sensitivity of the relays, the impedance of the reactance coils, and the amount of resistance between the neutral point and earth. This will be understood from the following explanation. If a fault to earth occurs at point E—Fig. 2—it will short circuit E and D, and also that part of the reactance coil lying between M and P through the relay. The other part of the reactance coil H M is still supplied with voltage from A E. The reactance coil operates therefore as a short-circuited transformer, H M being the primary and M P the secondary, and the current in the relay will depend upon the reactance between the two halves of the winding H M and M P and upon the impedance of the relay circuit. The leakage in the reactance coil can, if desired, be made very small at slight extra expense by special arrangement of the windings, and this method is therefore to be recommended if high earthing resistances are used. As an alternative, the size of the reactance coil can be somewhat larger than that of an ordinary potential transformer to obtain a small impedance.

A simplification of the described arrangement can be made in the case of a generator where the phases are wound in two parallel circuits—Fig. 4. In this case, the mid-points of the two parallel windings can be interconnected over the transformer which operates the relay. This system is very limited in its application, as few generators are wound in two parallel circuits, this being desirable only for extremely large currents. Further, it would be limited to 4-pole and 2-pole machines wound with concentric windings, as in 2-pole machines wound with involute or basket-type winding—similar to a direct-current armature—the mid-points in the windings of each pole are not equipotential. In some cases, however, the active conductors are divided in two parallel conductors lightly insulated from each other, and the parallel circuits are continued throughout the winding and twisted in the centre of the winding to avoid eddy currents. In such case equipotential mid-points can be created without great difficulty by omitting the twist in the centre of the winding and substituting two other twists, located half way between the mid-point and the extremities of the winding.

Fig. 5 shows an application of the mid-point protective gear for two alternating-current generators running in parallel. This arrangement has the disadvantage that two machines are tripped out when a fault occurs. The sound machine would, however, be immediately ready for synchronising. This disadvantage would perhaps not be important in a station where a large number of machines run in parallel. The great advantage of the arrangement is that extremely little gear is required, *i.e.*, only three current transformers and relays for each pair of generators.

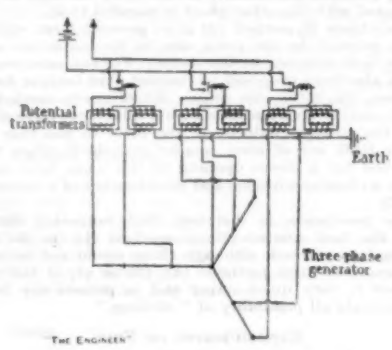


Fig. 3—Method of Connecting Protective Gear

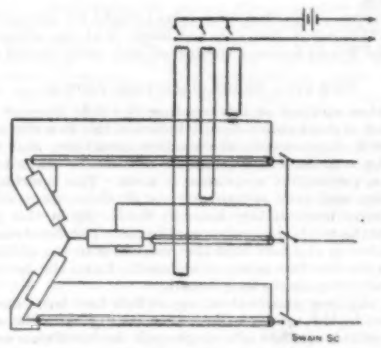


Fig. 4—Arrangement of Connections for two Parallel Circuits

AUTOMATIC FIELD SWITCHES.

A complete generator protective equipment should include an automatic field switch to interrupt the field circuit immediately the fault occurs. This field switch, so far as the protection of the generator is concerned, is as important as, if not more important than, the main switch.

The automatic field switch can be located in different parts of the field circuit, and can take the form of (1) a switch in the exciter field circuit, (2) a reversing switch in the exciter field circuit, (3) a circuit breaker in the main field circuit, (4) a switch to short circuit the slip rings and exciter.

Hitherto, in order to limit the voltage rise on breaking the induction circuit, it has been standard practice to provide a non-inductive field discharge resistance or "kicking coil" where a field circuit was to be opened. The normal operation of the field discharge switch is to connect the field winding in parallel with the discharge resistance and to open subsequently the current supply from the exciter armature. Thus, after the switching operation the field circuit is not interrupted, but the current circulating through the winding and the resistance is allowed to die out gradually. The ohmic value of the discharge resistance is, as a rule, roughly equal to the field resistance.

AUTOMATIC FIELD SWITCH IN EXCITER FIELD CIRCUIT.

A method which is frequently used is to provide a small automatic switch in the exciter field circuit.

If the exciter field is opened, the exciter voltage disappears fairly rapidly even if a discharge resistance is used, as the stored energy in the exciter field is small compared with the copper loss in the exciter field winding. After the disappearance of the excitation voltage, the main field current continues to circulate until the large amount of magnetic energy in the alternator field has been dissipated. The field winding during this time is practically short circuited on itself, and the resistance in the discharge path would be one-half the amount which would be in circuit in the case of a main field switch and a 1 : 1 discharge resistance. The time of the discharge being inversely proportional to the total resistance, the discharge would therefore be twice as long.

It is generally advisable to provide direct-connected exciters with a series winding supplying a small percentage of the total ampère-turns. This winding has the effect of making the exciter more stable in the case of rapid variations of the exciter field rheostat, and prevents loss of field and reversals of polarity on the exciter. If such compound-wound exciters are used in connection with an exciter field switch, the series winding has an additional retarding influence on the field discharge, which will therefore be extremely slow. In one case where this arrangement was adopted on a large unit, severe damage resulted to the stator winding and core during a stator breakdown.

Another minor disadvantage of locating the field switch

* Abstract of a paper read before the Institution of Electrical Engineers by Mr. J. A. Kuyser.

in the exciter field circuit is that, due to the remanence of the exciter field, the main current is not quite interrupted and the alternator voltage cannot be reduced below 5 per cent., approximate.

AUTOMATIC REVERSING SWITCH IN EXCITER FIELD CIRCUIT (SUICIDE CONNECTION).

In this method the field circuit of the exciter is opened and subsequently reversed. The reversal of the field has the advantage over the previous method that the remanence of the exciter is destroyed, and the remanent voltage on the alternating-current terminals reduced. The discharge time depends only upon the total resistance in the discharge path, and in this respect there is no advantage compared with the simple exciter field switch.

An advantage could be obtained from the use of a reversing switch, by exciting the exciter field coils separately from an independent source and allowing the exciter to generate reversed voltage. The maximum reversed voltage obtainable would be approximately 1½ times the full load excitation voltage, or four times the no-load excitation voltage. We have seen that the opening of the main field circuit produces an instantaneous reversed slip-ring voltage. This reversed voltage, is, at the moment of interruption, usually greater than 1½ times the full-load excitation voltage, but decreases gradually towards the end of the discharge.

The main field switch therefore produces a more rapid reduction of the current during the first period of the discharge, whereas the separately excited reversed exciter would give a more rapid reduction for the final part of the discharge. The most rapid discharge could therefore be obtained by the following sequence of operations :—(1) Open-circuit the main field ; (2) simultaneously reverse the separate excitation of exciter ; (3) close the main field again as soon as the reversed slip-ring voltage has dropped to a somewhat lower value than the reversed exciter voltage ; (4) open the main field as soon as the alternating-current voltage or the alternating-current fault currents—not slip-ring voltages—have dropped to zero, to prevent building up the main field in the reversed direction.

A system of quick-acting relays could be arranged to obtain this result, but it is not likely that the advantage obtained would warrant the use of such complicated gear.

SLIP-RING SHORT-CIRCUITING SWITCH.

Another method of interrupting the field current is to establish a dead short circuit between the two slip-rings. This will short-circuit the exciter armature, and some sparking will therefore occur on the exciter commutator unless a preventive resistance is used. This sparking is, however, not very severe, and is of short duration, as the exciter immediately loses its field. From this point of view the method is quite practicable. The disadvantage lies rather in the fact that the resistance in the discharge path is smaller than in any other method, and the discharge time correspondingly lengthened.

The slip-ring short-circuiting switch has been used in practice in the method illustrated in Fig. 6. The automatic switch consists of a single-pole double-throw switch in the main field circuit. Normally, the exciter armature is connected directly to the slip rings, and the resistance R is short circuited. In the operating position the slip rings are short-circuited, and the resistance is connected in series with the exciter armature. The exciter field is also short-circuited, and the exciter therefore is de-energised. The loading "resistance" eliminates sparking on the exciter commutator.

A disadvantage of this method is the sluggishness of the field discharge. Due to the fact that no external resistance is inserted in the main field circuit during the discharge, the discharge time is practically the same as for a switch in the exciter field circuit.

METHOD OF TRIPPING AUTO-FIELD SWITCH.

The field switch can be tripped in different ways, the following being those more usually adopted :—(1) Direct from the fault-current relays ; (2) by means of an auxiliary switch on the main alternating-current circuit breaker ; (3) by means of a combination of methods (1) and (2) ; (4) a time lag may be introduced after the tripping of the main switch.

If all apparatus belonging to the protective system could be absolutely depended upon, there is no doubt that method (1) would be preferable, on account of the more rapid action. It happens sometimes, however, that the relays operate for a fault outside the generator, due to faulty adjustment, or, if reverse-power relays are used, these may operate for a failure in the motive power. In these cases the field switch would be tripped, and, if we assume further that the main breaker fails to operate, due to a defect in the tripping mechanism, the sound machine will remain connected to the system with the field out of circuit. It is often assumed that such an operation contributes a grave danger. As a matter of fact, nothing serious happens if the field circuit of one of several parallel-running alternators is interrupted for a short time. The alternator if of the cylindrical type will operate as an induction generator, and increase its speed slightly, thus losing part of its watt load. The current drawn from the system will be mainly a wattless magnetising current, and this will cause a voltage drop on the system. This voltage drop will be severe only if the affected machines constitute a large percentage of the total plant capacity. The increase in speed can immediately be detected by the ear, due to the beats produced by the interference of the machines running at slightly different speeds.

A case has recently come to the author's knowledge in which the field of a 23,500-kVA alternator was interrupted, owing to an accidental opening by hand of the exciter field circuit. The machine was at the time operating in parallel with other plant of a capacity roughly equal to its own capacity. The current drawn from the line was observed to be approximately 60 per cent. of the full-load current, which corresponds to the magnetising current operating as an induction generator ; no other serious disturbance occurred. Other similar cases have occurred on sets of smaller capacity. It might be worth while to mention here that neither reverse power relays of the usual type nor balanced current relays will operate in the case of loss of field, as has sometimes been stated in literature and patents on this subject.

The next possibility is that in the case of faults occurring in the machine, the main alternating-current breaker fails to open. If the field is not interrupted, the system will feed into the fault, as will also the defective generator itself. If the field is interrupted, the faulty machine will not contribute to the fault currents. The energy flowing into the fault, and the damage, will therefore be appreciably reduced, particularly if the faulty machine is large compared with the other plant in parallel to it.

The object of method (4) is to prevent large voltages being induced in the rotor due to the inductive effect of the fault currents in the stator. For the same reason, it has also been proposed to connect over-tension devices between the rotor slip rings. Experiments carried out by the author on a machine with a solid rotor have shown that the voltages induced in the rotor in the case of a stator fault are of even smaller magnitude than those observed for a direct opening of the main field circuit under no-load conditions, and therefore not of a dangerous nature.

The conclusion is therefore that operation directly from the fault-current relays—method (1)—is the most satisfactory method, although there would not be much to choose between methods (1), (2) or (3) if the main breaker is very quick-acting and is periodically tested to eliminate all possibility of "sticking."

EXTINGUISHING OF FIRE.

Although the installation of electrical protective devices greatly reduces the possibility of fire in the windings, it is still advisable to provide means for extinguishing a fire in the extreme case of the protective gear failing and the winding becoming ignited.

In addition to the use of air dampers some engineers strongly recommend the provision of pipes inside the end bells, through which steam may be turned upon the windings. This method is being employed by several power-station engineers, more particularly on the Continent and in the United States, and seems to give good results. Interesting data on this subject are given by M. A. Savage in the *General Electric Review*, January, 1918.

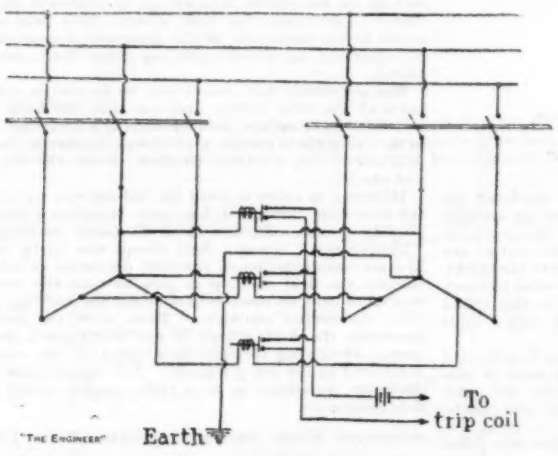


Fig. 5—Mid-point Protective Gear for Two Alternators in Parallel

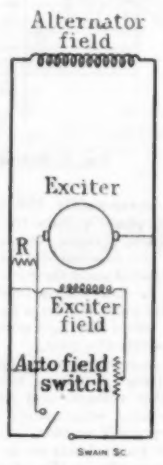


Fig. 6—Connections for Field Suppression Scheme

THE research work carried on by the Société de Recherches de Vaux, with the co-operation of the Forages et Entreprises Minières, surrounding the village of Vaux, resulted, according to *Industrial Gases*, in an important discovery of natural gas, at a depth of about 350 m. There is hope that the continuation of the work will result in important oil discoveries. A still more important result has been attained by the Société d'Etudes et de Recherches Petrolifères, which operates in the same area, near the village of Torcieu, with the co-operation of the Société Nouvelle des Sondages de Bonne-Espérance. They found a huge stock of natural gas, the daily supply of which reaches, at present, more than 100,000 cubic metres.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

The Engineering Dispute.

SIR WILLIAM MACKENZIE'S report on his inquiry into the engineering trade dispute has formed one of the chief topics of discussion in Midland industrial circles this week. The re-opening of negotiations gives much satisfaction, and a strong hope is held that they will this time produce a satisfactory result. There is one point which cannot be emphasised too strongly. There must be good sense and good will between the parties, and "an appreciation by either side of the difficulties and point of view of the other." Meanwhile it is satisfactory to be able to report that in a good many factories in Birmingham and the Midlands, at any rate, the dispute is now in a fair way of settling itself. There are works in which the number of men out now is so small that the production is hardly affected at all. There are others in which only a section of the work is at all substantially held up, and there is a growing disposition all round for more and more men to take advantage of the opening of the factories and get back to their jobs. There is a disposition also on the part of a good many steady, quiet men, who never make their voices heard in the branches, to break away from their unions, and if it were not for the fact that contributions over a long period of years, carrying with them pensions and other advantages, were involved, many more of the older men would follow this course. With regard to the position in Coventry and the surrounding districts, reports as to the number of men working in the federated shops are considered by the Employers' Association very satisfactory.

Reduced Transit Rates.

There is keen disappointment in Birmingham and the Midlands at the meagre nature of the reductions in transit rates just announced by the Railway Clearing House. The reductions, small as they are, deal chiefly with the carriage of coal and raw materials, principally for shipment to blast-furnaces, steel works, &c., and have no effect whatever on general merchandise. Mr. G. F. Bilborough, of the railway department of the Birmingham Chamber of Commerce, considers the reductions as quite inadequate and exceedingly disappointing after the strong representations made on behalf of traders generally. He hoped it could be assumed that the intimations were merely preliminary to the reductions traders desired. Mr. G. H. Wright, secretary of the Birmingham Chamber of Commerce, holds that the effect on the whole trade of the country will be negligible, and he questions whether the reductions will be of any real advantage to the steel works and blast-furnaces. A further opinion is that, generally speaking, the concessions hardly touch the fringe of the revision, and that so far as the local iron and steel trades are concerned the result is more or less negligible. The reductions as they affect the coal industry are considered to be practically useless and not likely appreciably to benefit either the consumer or the trade in general. A penny a ton reduction on the flat rate for industrial fuel is not regarded as sufficient to give the necessary impetus to trade revival, which cheap coal can do more than anything else to stimulate.

The Development of Inland Waterways.

A further step in the development of inland waterways has just taken been by the formation at a meeting in Birmingham, of a National Council for Inland Waterways, which body is the lineal successor of the Inland Waterways Association, the activities of which were held up during the war, and which is now in process of dissolution. Birmingham manufacturers and traders generally, are deeply interested in this matter of canalisation, for living in an inland district such as this they are only too well aware how trade is being hampered by the heavy cost of rail transport to and from the seaboard. As far as the iron and steel industries of this district are concerned they have been, and are practically excluded from doing an export business, being unable to compete, on account of the freights, with firms situated nearer the coast. For some time past it has been held that we were not making the use that might be made of our waterway routes, and it has been considered desirable to form a body which should focus the general interest which was felt by traders, users of waterways, and consumers generally, in anything which would give a prospect of lower transport rates. The outcome has been the formation of this new Council which is to have Mr. Neville Chamberlain as President. The new association will consist of representatives of trade organisations, independent canal companies, canal carriers and users and all interested in promoting trade by water. Its objects include the development of inland waterways and of local and through traffic, and the establishment of waterways as an integral part of our transport system. At no time has this district been in greater need of efficient inland water transit than it is now, and hopes are expressed that something really tangible will result from the activities of the new Council. Alderman George Cadbury, jun., has pointed out the possibility of through transport with the Continent and Birmingham by means of a little development of the existing waterways. Three or four months ago, for the first time in history, a series of 250-ton barges, with timber, reached Worcester, having came all the way from the Continent by water. Only about 13 miles of canal and some obsolete locks would have to be reconstructed to make it possible for those barges to reach Birmingham.

Midland Pig Iron for Abroad.

Production of pig iron continues to be at a low ebb in South Staffordshire, and there is no probability of more blast-furnaces being rekindled just yet. So far as the foundry pig iron section is concerned, values are practically maintained, but there is no improvement in the trade in forge qualities. With coke prices maintaining firmness, sellers of pig iron find it possible to hold prices

which are generally considered to have a firmer tendency. There is an idea in the engineering trade that the dispute will not be prolonged, and that its termination will introduce a period of higher prices. Consequently orders are being placed in quite sufficient numbers to absorb, with a substantial export business, the production of the comparatively few Midland furnaces in operation. In some cases the furnaces are linked with companies not sufficiently affected by the lock-out to have their trade materially interfered with, and this is supplying a very useful market for pig iron. Some of the Midland furnaces are participating in the shipments to the Continent. Naturally Cleveland is profiting much more than districts further from the coast by the requirements of neighbours who, not many months ago, were sending iron over here in large quantities. But Cleveland is not enjoying a monopoly of these new outlets. Indeed, one or two Northampton furnaces are now shipping a substantial part of their production further down the coast, and some Derbyshire smelters are also fulfilling export orders; one 1000-ton lot of Midland pig has been sold as a result of inquiry from America. These shipments have sufficed to maintain prices, but they have not caused any advance, thus proving that the foreign trade is well within the compass of current output. For the home trade business is, with a few exceptions, conducted on hand-to-mouth lines, buyers being reluctant to enter into commitments of any magnitude till they can see their way more clearly.

Business in Bar Iron.

There is no new development in the Staffordshire manufactured iron trade. What business there is is of a spasmodic character, which does not make for price stabilisation. The basis of £13 10s. for marked bars is maintained, but prices of second quality finished iron have given somewhat. £11 is no longer recognised as the standard for merchant iron. Some merchants claim to have bought at 5s. below this figure. There is an increasing amount of competition for the business that is passing in this branch. The nut and bolt industry at Darlaston is rather busier, but with buying on the hand-to-mouth principle, there is no disposition to purchase Belgian iron at £9 4s. Local ironmasters quote £10 2s. 6d. for nut and bolt qualities and £10 5s. for fencing bars. In every part of the market there is repression of enterprise, relieved by the hope that Sir William Mackenzie's report on the engineering impasse will have the effect of focussing attention on the realities. While the Staffordshire iron trade continues generally depressed, certain developments are regarded as encouraging. Some of the larger merchants are doing an increasing business with India, both in iron and steel, though, in this case, some of the material is being sent from Antwerp, owing to the cheaper cost of transit from that port, as compared with British iron and steel sent from London. Among recent orders are iron and steel for barge building and repairs, chiefly on account of Thames requirements. The local ironmasters, who specialise in re-rolling are supplying fair quantities of steel strip for tube making. This business is mostly for home requirements, the competition of Germany, America and Canada being increasingly keen in foreign markets. There appears to be a good demand for wrought iron scrap. But as consumers are not prepared to pay more than £3 10s. the holders of this material decline to sell, being of opinion that better prices will be obtainable in the near future. A moderate trade is being done in galvanised sheets at £16 5s., and the demand for black sheets has improved a little.

Steel Business.

Steel is not so active of late, owing chiefly to the prolongation of the engineering dispute. The spurt in sheet bars is dying away. It is difficult to ascertain actual values because there is no demand worth the serious attention of sellers. There is a very prevalent belief that a good order would not be refused at something substantially below the nominal quotation of £7 15s. In the case of a big order it might be possible to do business at £7 10s. On the other hand, some local firms which have been quoting £8 still maintain this figure, in view of their favourable position. Steel bars range from £9 5s. to £9 10s., and steel hoops are £11 10s. and upwards at works. Steel scrap has become scarce. A rather keen contest over prices has ended in favour of the seller, one large buyer who a few weeks ago declined to pay more than £2 17s. 6d., having recently concluded a contract at £3 5s. delivered in South Wales. Foreign steel competition has become ineffective, several recent quotations being in excess of home prices. Indian business appears to be opening out. While some good orders have found their way to home works, some rather attractive business has gone to the Continent, solely on account of the prevailing labour troubles.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER, Thursday.

Iron and Steel.

THERE is this week a revival of the hope that by some means an agreement may be reached to end the engineering stoppage in this district, and as a consequence the iron and metal markets have a more cheerful appearance, although very little actual business is being done. The fact that the A.E.U. has consented to join in the negotiations with the other unions is taken to mean that something may now be accomplished. It is reported here that in the Midland districts a good many men have accepted the masters' invitation to resume work, but this is certainly not the case yet in the Lancashire district, although the fact that men in other places are coming in may be a good omen for Lancashire. It is difficult to say how much work has been lost by the stoppage, and perhaps one would be too sanguine to expect that active business will be suddenly resumed at the end of the lock-out; more probably we shall get back only slowly to a normal state of things, but as the output of iron and steel is only small, there may be a sufficient demand to maintain the prices.

Metals.

The position in the copper market is generally considered to be sound, and the current prices are low enough to act as a stimulant to buyers so soon as there is a reasonable prospect of business in the engineering trade. Many of the large consumers have only a small stock of metals in hand, and if there is no general apprehension of lower prices, these firms might soon become good buyers of refined copper. The demand for new copper from the brass-working firms may, however, be small for some time, because there is still far too much cheap scrap brass available. A considerable proportion of this has been bought by dealers at prices which will allow them to sell at £20 per ton below the cost of mixing new brass, and this is far too great a difference. The American position in the copper trade is thought to be gradually getting sounder, and there has been some diminution of the surplus stocks held in that country. On the Continent, the question has been raised as to the possibility of getting at the very large amount of old copper and brass which exists in Russia. Probably Germany will have the best chance of dealing with these accumulations, and if they could be utilised, they would render Germany independent of supplies from America; but there will be enormous difficulties until the transport system in Russia has been reorganised. It does not seem probable that supplies of old metal from Russia can have much effect on the markets this year. The quotations for refined copper have remained steady now for a long time, and there has been no change during the last fortnight in manufactured material. The demand for sheets, tubes, &c., in this country has been, of course, small, and the export demand for copper sheets is affected by the fact that America is offering sheets to the East at much below the prices wanted in Great Britain. Tin has been steady and rather quiet of late, and the price seems to be settling round about £150 per ton. It is said that the rate of consumption is now equal to the current production, and some people say a little superior, so that it is possible that an impression may be made during the current year on the big stocks held in reserve. There is some restriction of output being practised. In the market for lead, the widening of the difference between prompt and forward metal is a feature which suggests that the position is unhealthy. There is considerable "tightness" so far as May deliveries are concerned, but a backwardation of nearly 30s. per ton on lead is ominous. The policy for consumers of lead would seem to be to avoid buying as much as possible until this discrepancy between spot and forward prices disappears. In spelter there is practically no change. The galvanisers are taking a moderate amount; but brass makers very little. The supply of Australian concentrates to Belgium will scarcely affect the market this year.

Pig Iron.

The market for foundry iron here is waiting for definite news of a settlement of the dispute, but one notices that there is rather more disposition to buy, and some consumers are impressed by the confidence of sellers that for a time the price of No. 3 will be higher. It may be so, but one finds a difficulty in believing that the rise can be permanent or can last very long, because there are too many furnaces waiting for an opportunity to start, and now that the railway companies have agreed to reduce the rate in blast-furnace material to 50 per cent. above pre-war rates, these furnaces will have an additional reason for the favourable consideration of the question as to whether or not they should remain longer idle. Those who look for higher prices for pig iron must not forget that our output in Great Britain is still not much more than one-third of the normal. The consuming trades ought to be able to deal with the remaining two-thirds before there is any probability of a permanent rise in the price. There has been some buying going on here at 92s. 6d. per ton for Midland No. 3 delivered in Manchester, but it has not yet reached any great proportions.

Finished Material.

The demand for finished iron and steel has not shown any revival yet, but it is hoped—and by some people it is confidently expected—that there will be much better buying next week. The works are certainly in need of such buying, for they are woefully short of large convenient specifications. The nominal prices for iron and steel remain as they were.

Scrap.

The better feeling has not yet reached the market for scrap iron and steel, and very little business is reported in this district. Dealers seem to be hoping that if pig iron becomes dearer they will be able to sell foundry scrap more freely and on higher terms. The former may be possible, but one doubts whether the prices for foundry scrap can be put up in any case. There are too many people anxious to get orders. Wrought scrap and steel scrap are unchanged, and very little is heard about them.

More Labour Troubles in the Cotton Trade.

Unless a settlement is arrived at within the next week or so the operatives in the Lancashire spinning mills, numbering 120,000, will receive lock-out notices. The trouble has arisen over the rates of pay for a certain operation at a mill at Royton and over the speeding-up of the mules at another mill. It is hoped that the good sense which prevailed in the recent dispute will again reassert itself, and that a settlement will be arrived at.

Tanks and Chain Track Artillery.

There was an audience of between 800 and 900 persons to hear Mr. L. A. Legros' lecture on "Tanks and Chain Track Artillery," given under the auspices of the North-Western Branch of the Institution of Mechanical Engineers at the Manchester College of Technology, on the 11th inst. Mr. Charles Day, the chairman of the Branch, presided, and in proposing a vote of thanks to Mr. Legros, made reference to the important part played by Manchester engineers in the development and production of these implements of warfare, particularly with regard to the manufacture of a smokeless internal combustion engine, the evolution of which was largely due to the firm of Mirrlees, Bickerton and Day, Limited. The lecture has already been printed in THE ENGINEER—see the issues of December 2nd, 9th and 16th, 1921.

Manchester's New Super Power Station.

By the courtesy of the city electrical engineer, Mr. S. L. Pearce, I was given an opportunity a few days ago of paying a visit of inspection to the new super power station, which is now in course of erection on the banks of the Ship Canal at Barton. It is only by an actual survey of such a great undertaking as this that one can realise the many-sidedness of the engineering problem which must have presented itself on the initiation of the scheme, and one cannot fail to be struck by the wisdom of the choice of site. The first great essential for a modern electricity generating station is an adequate supply of water for condensing purposes. This is of greater importance even than proximity to a coalfield, but the Barton station possesses the advantages of both, and there is the additional advantage that the Bridgwater Canal comes right up to the works by means of which, coal can be delivered from collieries not more than 3 to 4 miles distant. Altogether, the site on which the station is being erected, and is rapidly approaching completion, measures about 13 acres. The foundations are excellent, being on red sandstone. The culverts for the supply of condensing water from the Ship Canal and for its return after use, have been constructed, and they are large enough to pass 7½ million gallons of water per hour. The intake and outlet chambers are over 600 yards apart. The inlet chamber is designed so as to allow of a substantial drop in the Ship Canal level, and still provide sufficient flow in the culverts, the inlet culvert being 330 yards long and the outlet 400 yards long. The culverts are driven through the red sandstone and lined internally with two rings of brickwork. The inlet chamber is provided with main sluice gates, behind which stoppers are fitted to seal the culverts. Behind these, again, are two sets of screens and revolving type Brackett screens. The outlet chamber is provided with a long central weir, which enables the discharged water to be measured and passed back again into the Canal through a number of openings, so as to spread the discharge over a large area below the surface of the water, and thus avoid interference with the traffic on the Canal. In order to deal with the coal traffic coming *viâ* the Bridgwater Canal, a dock and a layby are in course of construction. These and the railway sidings are so laid out as to enable the coal to be expeditiously delivered and unloaded into the boiler-house. The latter will be equipped with Babcock boilers to work at a pressure of 375 lb. per square inch, with superheaters, steel tube economisers, air heaters and balanced draught. The heating sections of the boilers are arranged back to back for double-end firing, and the heating surface is 16,020 square feet. Below the boiler-room and on the ground level is the ash cellar, which will admit full-size railway trucks to pass directly under the ash hoppers. The electric generating plant for the first section of the station will comprise three turbo-generators of 27,500-kilowatt maximum continuous rating, or 30,000 kilowatts each for short periods, generating three-phase current at 50 periods and 6600 volts. These are being built by Metropolitan-Vickers Electric Company, Limited, and the condensers, one of which is already in position, are by Richardsons, Westgarth and Co., Limited. Each condenser will weigh 50 tons without the tubes, and will have a tube area of 40,000 square feet. The whole of the switch gear and main transformers for raising the generator pressure up to 33,000 volts is situated in a separate building parallel to the turbine room. The whole of this high and low-tension gear is being supplied by the British Thomson-Houston Company. The transmission cable contract has been let to Callenders, and comprises 0.3 square inch, 33,000-volt, three-core, paper-insulated, lead-covered and armoured cable laid direct in the ground. Four of these have already been laid, each having a capacity of 18,000 kVA; one direct to Stewart-street station, one to Oldham-road sub-station, and two to High-street sub-station, one of the latter serving the Moss Side sub-station. The site is capable of accommodating another station of equal capacity when this is required, and it is hoped that the first portion of the system will be in service by the end of the year. The Barton scheme will play an important part in the supply of electricity in the South-east Lancashire electricity area, and it is anticipated that the new Electricity Board which will be charged with the administration of the electricity supply of this district will be set up in the autumn of this year.

BARROW-IN-FURNESS, Thursday.

Pig Iron.

Despite the very unsettled state of the engineering and shipbuilding trade in the country, the hematite pig iron trade continues to show signs of life. Many of the regular customers are only ordering small deliveries, and are living from hand to mouth, but there is a growing trade in other directions which is rather comforting. The local steel works take a fair amount of the iron smelted, and there are constant shipments to home ports and abroad. Apart from Antwerp and French ports, Italy is becoming a customer, and a cargo of several thousand tons will be shipped this week or next by a vessel which will discharge Spanish ore. Such signs as these of a broadening of the trade are inclined to make one hope that when labour troubles are settled the district will enter upon a period of activity.

Iron Ore.

The trade in local sorts is about the same, and some of the mines are moderately busy. There is not much chance of an improvement until the air is clearer. The same remark applies to foreign ores, which are regularly arriving at the West Coast ports in moderate quantities. Spanish ore is in fair demand, and there is no alteration in price yet.

Steel.

There is not a great activity in the steel trade, taking it on the whole. The rail mill is still engaged at Barrow, as also are the hoop mills, the merchant mill and the steel foundry. The hoop mill is most active, and has for the last month been engaged upon hoops on American account. It is understood that America inquired for 15,000 tons of hoops for the new cotton crop, and Barrow has got its share. It may be that the coal strike in America has sent this order through to this country. The ex-German battleship Westfalen has arrived here to be broken up.

SHEFFIELD.

(From our own Correspondent.)

Nearing a Stoppage.

A TOTAL cessation of work in the steel and engineering trades here is appreciably nearer realisation than when I wrote a week ago. The "mass picketing" methods to which attention was then directed were allowed to continue unchallenged till the end of the week, when a strong reinforcement of police was brought in from outside districts, at a cost to the city of something like £250 to £300 per day. By this time, however, the followers of this form of "peaceful persuasion" had become so emboldened by the success of their efforts—shop after shop having closed as a result of their intimidation—that they strongly resented this belated show of resistance on the part of the authorities, and on Monday there was a serious encounter between a crowd of some two or three thousand men, deliberately marshalled in one of the frequented thoroughfares and marched by their leaders a couple of miles through the main streets to the works of William Jessop and Sons, Limited, where it was supposed a number of men were still employed. The two or three police officers left to guard the works gates were soon overpowered, but before any serious damage—beyond the breaking of windows—was accomplished, a detachment of mounted police and a motor-coach load of constables arrived on the scene, but there were some ugly rushes before the crowd was finally dispersed. Other firms had already closed down rather than risk their property and the safety of their men, and others continued working in a secretive manner with a few men on urgent orders. Generally speaking, however, the locked-out men and strikers have come within sight of realising their avowed intention of bringing the wheels of industry to a standstill in this district, and unless a settlement of the dispute is reached or the forces of law and order still further strengthened, the city will gain an unenviable notoriety.

Cheaper Rails.

It has been a matter of surprise and complaint that Sheffield firms have for many years past refrained from tendering for the supply of rails required by the Corporation Tramways Department. Now, however, Steel, Peech and Tozer, Limited—one of the big firms associated with the United Steel Company—have succeeded in submitting the lowest tender received for some years past, and between the time when the tender was considered by the Tramways Committee and their recommendation coming before the City Council, the firm offered further to reduce this tender—£12 10s. per ton—by £1 per ton, provided the order could be increased from 200 to 500 tons. Although the Council felt that in the present need for the strictest economy, an order could be placed only for the actual immediate requirements of the Department, it is quite possible the Tramways Committee will make a bargain with the firm, in order to stimulate local trade. The production of tram rails has been one of the few departments which has of late been fairly busy. There has also been a certain amount of activity in railway material, Sheffield having of course shared in the heavy shipment to India which the Board of Trade returns reveal. The special steel departments have, however, been quieter than ever, and even makers of stainless steel and rustless iron, who, for a long time past, had been unable to keep pace with demand, report a distinct falling off. A few firms have been well employed on engineers' small tools, saws, and files, but they have, of course, now experienced the inevitable effects of the prolonged stoppage in the engineering trades, and there is comparatively little being done in these departments.

Motor Trade Revival.

Sheffield firms are watching with the keenest interest every sign of a revival in the motor car industry, for which they supply a large proportion of the high-class steel required, and much of the forgings, including the crank shafts for some of the most famous cars on the market. The revival is, however, painfully slow, and at present it calls for only a very small proportion of the output capacity of local works. There is, however, a distinct boom in cycling, and this spells prosperity for a certain number of Sheffield firms who specialise in many of the small parts, which are turned out on mass production lines. The skilled labour involved and the steel consumed in this work are, however, a very small item in comparison with the productive capacity of the city. Something on a very much bigger scale is wanted to restore anything like general prosperity to Sheffield. An extensive policy of railway repair and renewal would help, but a comprehensive shipbuilding programme would be far more effective.

Lower Rail Rates.

Steel makers welcome the railway companies' announcement of further reductions in rates, as these mainly affect coal, ores and other materials for blast-furnaces and steel works. If, as is hoped, the operation of these new rates will approximately coincide with a settlement of the engineering dispute, the double event should greatly encourage the steel and engineering industry to make the strongest possible bid for the business which it is generally conceded is awaiting distribution. At the same time the concessions are on none too generous a scale, and are far short of the trading organisations' demands. It has to be remembered that during the present year the railway companies have been buying their coal for locomotive purposes at 21s. per ton at the pit, as compared with 32s. 8d. per ton up to the end of last year. They have thus saved at the rate of between £9,000,000 and £10,000,000 per annum, in addition to other very substantial reductions in prices of all other materials and stores, and in railwaymen's wages, while, on the other hand, they are receiving a gift from the Government of about £60,000,000, a comparatively small portion of which has either been distributed in dividends to shareholders or expended on repairs and renewals.

Fuels and Ferro-alloys.

The fuel position has not materially changed during the past week. There is, of course, a decreasing demand for industrial fuels for home consumption, though the export business is rather better. On the Sheffield Coal Exchange business was generally on the weak side, and quotations were erratic, varying largely with the stocks at the collieries, some of which are reaching very considerable dimensions, and owners are ready to accept almost any price to effect a clearance. Coke for blast-furnace use at home proved something of a drug on the market, though exporters are taking good supplies. The only steel-making alloy in which any interest is taken seems to be ferro-silicon, several makers of which are booked well into June, while others are encouraged to make a re-start after having been shut down during the slump. Prices are firm, especially for the 45 per cent. quality, of which there is not much available for early delivery. Ferro-chrome is very flat, and buying for making rustless iron and steel has been falling off lately. Ferro-tungsten is said to be on the turn, but very small quantities are at present being bought at current prices, 1s. 4d. per lb. and powder at 1s. 6d. Wolfram, on the other hand is being sought and values are rising rapidly, recent sales being at 11s. per unit for forward delivery, while some sellers are asking a shilling or two more. Ferro-vanadium has fallen to 18s. and 19s. per lb., and this as well as molybdenum, cobalt, aluminium and nickel are all neglected.

NORTH OF ENGLAND.

(From our own Correspondent.)

The New Railway Rates.

For a long time past trade has been sorely handicapped by the excessively high railway rates, and therefore the reductions which have been effected, modest as they are, will be generally welcomed. The railway companies have certainly undertaken a helpful course, but manufacturers would probably have been better pleased had a 50 per cent. increase over the base rates for all trades, and an entire abolition of the flat rates, been approved instead. The flat rates have been decreased in the latest proposals, but, having regard to the peculiar circumstances attaching to the trade of the North-East Coast, in so far as the carriage of raw materials and finished products are concerned, the traffic, it should be noted, is very largely for short distances. In this instance the modification of the flat rate appears to be unfair and unequal in its incidence. As an example, take Class "C" of the railway rates classification, covering iron and steel for export, carried from Middlesbrough works to Middlesbrough docks. The base rate was 1s. 0½d. per ton. The present rate is 2s. 10d. Included in that 2s. 10d. is a flat rate of 9d., which represents 75 per cent. of the base rate. The new rate will be 2s. 4d., including a flat rate of 6d., which is 50 per cent. of the base rate. Hence, although the modifications are general, their incidence in regard to Middlesbrough is peculiar. On the other hand, it will be noted with some satisfaction that Class "C," as comprising finished steel manufactures, has been revised and some measure of abatement in the previous rates found possible, after the industry had waited so long for some tangible assistance, but it is bound to be regretted that the reductions really mean so little. The general view appears to be that they are not nearly sufficient to stimulate trade to any extent as far as can be seen. The position is the more severe when it is remembered how important the facilitating of export traffic is, whilst manufacturers are fighting to secure lost ground in the continental and general markets abroad. The freights for products from continental ports for like commodities as from Middlesbrough are 7s. 6d. per ton less than f.o.b. at Middlesbrough port, the reason being that the dock charges are only about one-third at Antwerp as compared with Middlesbrough. This further aggravates the position. It is therefore necessary that immediate alleviation should come in the home dock charges, and that the railway companies should lend every possible assistance towards lessening the tremendous difficulties the home trade is up against. Had the decrease in the rates now effected been in the neighbourhood of 50 per cent., and had the flat rates been abolished, it would have been in the nature of an impetus of more or less permanent character and not a partial stimulant which may not have the desired object. So far as coal is concerned—a matter of widest import to industry—the new reductions in carriage rates amount practically to nil, only making a penny per ton less. Although the reduction in the maximum amount leviable may be appreciable for long-distance traffic, there is little benefit locally.

Cleveland Iron Trade.

The position in the Cleveland pig iron trade shows little change on the week. The new railway rates on the raw materials of the industry have not aroused much enthusiasm. They are regarded as a step in the right direction, but no more than that. The effect on the cost of production is very small indeed, and consequently no reduction in the price of pig iron is possible, as there will still be no margin of profit. The chief restrictive influence at the moment is the uncertainty created by the engineers' lock-out. Through its paralysing effect the home trade has dwindled to very small proportions, and only the continued support of foreign buyers has prevented some of the furnaces going out of operation. There are still quite a number of inquiries in circulation from European consumers, and the export business is fairly active. But it is the home market which is the chief support of the industry, and the home demand was seldom so small as at present. Prices are firmly maintained, No. 1 and siliceous iron being 95s., No. 3 G.M.B. 90s., No. 4 foundry 87s. 6d., No. 4 forge 85s., and mottled and white 80s.

Hematite Pig Iron.

It is reported that stocks are beginning to accumulate in the East Coast hematite pig iron trade, and some of the makers are keen to realise. Others, apparently, are well sold, for whilst it is possible to buy mixed numbers at 96s., and No. 1 at 97s., some of the makers will not quote less than 97s. 6d. and 98s. 6d. per ton respectively.

Iron-making Materials.

The foreign ore trade presents some curious contrasts at the moment. Sellers find it almost impossible to book new business, and only an occasional cargo is being bought by consumers who may want a special ore to preserve their customary mixture. On the other hand, deliveries under running contracts have seldom been so heavy. Prices are unchanged, best Rubio ore being nominally at 27s. per ton c.i.f.

Manufactured Iron and Steel.

The manufactured iron and steel trade is deadly dull. No effort is spared to get business, and many orders are accepted with the certain prospect of financial loss, yet even so only a small proportion of the plant is kept working. There is, perhaps, just a little more inquiry from abroad for railway material, but competition is very keen. Prices are unchanged.

The Coal Trade.

The Northern coal trade position is not much disturbed from the conditions which have prevailed during the past few weeks. The whole situation is apparently satisfactory and assured, with a ready outlet for the whole of the output at present. At the same time the views expressed by many who are qualified to judge are divergent and contradictory. Some hold that the forward position will improve gradually, if slowly, while others are equally confident that the near future will witness a gradual, but steady, declension, concurrent with a lowering of prices all round. In the meantime, the heavy purchases which have recently been made, and are still proceeding, for Germany have come at a very opportune moment, and have for the present averted a probable slump in prices. The demand from France and Italy is poor, but things are looking brighter in regard to most of the Scandinavian countries, which are feeling the market all round with an eye to future requirements. Steam coals are steady for best Northumberlands, and some selected Durhams, but Tyne primes are only moderately upheld. Smalls are in good request, but unscreened steams are easy. Wear special gas, with prime qualities, are strong, with a fair outlook for secondary gas coals. Coking is patchy and irregular, although some brands are well placed. Bunkers are in good demand for ships' use, but for overseas the demand is not large. There is not much life in the coke market. Patent oven foundry coke is fairly steady, but gas coke is only moderately inquired for at current prices.

Heavy Russian Purchase of Coal.

The Soviet Government of Russia has placed orders with a Newcastle firm of exporters for 300,000 to 500,000 tons of Northumberland steam coals, in monthly quantities of 65,000 tons or more per month during the season from June to September or later. The prices paid are said to be in close relation to the current market values.

SCOTLAND.

(From our own Correspondent.)

New Contracts.

REPORTS of new contracts to hand include the following:—Colville and Sons, Motherwell, to supply 1624 tons of steel for the Auckland Harbour Board, New Zealand. American and continental firms also competed for this contract, but Messrs. Colville's tender, reported at £19,800, is said to be the lowest. The Caledonian Railway Company has placed an order for seventeen passenger coaches of the four-wheel bogie type with R. Y. Pickering and Co., also of Motherwell. This order is in addition to others given to Clayton, Limited, and the Midland Carriage Company, both of Birmingham. Locomotive builders have a number of specifications in hand for both home and colonial and foreign railways, and better times are in prospect.

Steel and Iron.

The steel and iron markets continue more or less in a state of suspense, and matters are not likely to improve so long as the engineering trouble lasts. Stocks are low, but consumers still order only for absolutely immediate requirements, and the turnover in all classes of material is meagre in the extreme. Inquiries from abroad indicate the presence of business, but everything depends on the accomplishment of industrial peace. Home business is more dead than alive, and only the receipt of overseas inquiries already alluded to keeps the markets from complete stagnation. Steelplates, sheets and sectional material, bar iron, pig iron, and kindred materials are all greatly in need of orders. The re-start at the shipyards is certainly a step in the right direction, but until the engineers are once again in action business must be retarded. Foreign Governments are inquiring for steel, and bar iron also is wanted. The latter is meeting with next to no demand

on home account, and the cutting in progress for export orders leaves little room for profit. Amongst others, India and South America are said to be wanting material, but the industrial trouble is an effective barrier to the naming of deliveries. The number of orders already lost is surely an incentive to end the dispute, apart from the relief to the unemployment which is rife at present.

Coal.

The Scotch coal trade is still a difficult proposition. Orders are not plentiful, while the business passing is as often as not unremunerative. Consumers continue to buy from day to day, even the probability of still cheaper prices for large lots being no inducement at present. As a matter of fact, even for small lots prices are in most cases a matter of arrangement. Home demands are very poor, for which, of course, the industrial situation is largely to blame. The removal of the restriction on imports of British coal into Hamburg has improved the outlook in the Lothians and Fifeshire. Exports from the former show a substantial increase. Generally speaking, round coal is in poor demand, and small stuffs still compose the greater proportion of the turnover. Aggregate shipments for the week amounted to 270,295 tons against 212,402 tons in the preceding week, and 337,073 tons in the same week in 1913. Prices are most erratic, navigations, navigation smalls, single nuts and pearls alone remaining comparatively firm. Other prices named are subject to considerable adjustment.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Position.

ALL things considered, the steam coal trade maintains a good tone, but it cannot be disguised that it is not quite as firm as it was a little while ago, and it is evident that the lack of general inquiry from abroad, notably from France and Italy, is quietly but steadily having an effect upon the market, with the result that colliery salesmen are more content to get the prices that are ruling than endeavour to get anything above them. Stocks abroad are still on such a scale that they operate against a revival in the demand, but while it is possible that the market may shortly ease down to some extent, it is unlikely that prices will give way to a marked extent, as coalowners have a fair amount of business on their books, and therefore can display a certain amount of independence. Shipments are proceeding on a fairly active scale, and it certainly is a matter for grave thought that, while we are sending our good coal abroad it is being done at a price which yields very little profit for the coalowner, and the shipowner is losing money at the rates of freight obtainable for the carriage of the cargoes. Furthermore, France is doing her best to put into practical operation the idea that coals for France shall only be lifted by French-owned tonnage. The present position, so far as shipowners are concerned, is a serious problem, and the question is naturally asked how long is this situation going to last. Unfortunately, the outlook does not appear too promising, particularly with the summer months before us, when the coal trade is usually rather quieter. The coal market is not bare of enquiries, but the trouble is that this district is in competition with others, and buyers abroad do not consider that they are getting value for their money in conceding the difference in the price that is now ruling, as between South Wales coal and supplies from the Northern areas, and the result is that this district does not stand much chance when tendering for business. Information which is to hand does not indicate that the Danish State Railways have bought any coals from South Wales, although it is reported that they have bought from the North about 40,000 tons. At the time that prices went in fears were entertained that the bulk of the order would go North. There have been rumours that substantial inquiries were in circulation for Russia, but the market is rather sceptical regarding the probability of anything coming of them, while the Chilian State Railways are stated to be requiring offers of 50,000 tons of steam coals for delivery over twelve months. The Italian Government is credited with wanting prices for half a million tons of steam coals for shipment over the next twelve months, but whether it is likely to buy is another matter. If the prices are all right it may do so, otherwise the chances are that it will continue to go on the hand-to-mouth principle.

Labour Conditions.

Unfortunately, it is not possible to regard the labour outlook as more hopeful. The men's leaders are, if anything, becoming more aggressive, and one of them declares that they are preparing for action. He contends that he has never experienced such a clamour on the part of the members of the Federation for strike action, and that during the past few weeks those outside the Federation have been rolling in in their thousands, with the result that their membership is at least 90 per cent. of those employed, and those that have joined the Federation are resolved to clear the coalfield of non-unionists. There is no doubt that a strong campaign is being initiated against the non-unionist as a preliminary to an assault upon the citadel of the coalowners, so that unless a more conciliatory spirit prevails on both sides there is the chance that next month the coalfield may be the scene of untoward developments that will be disastrous to everyone and the country generally.

Rail and Dock Charges.

The reductions in rates for coal, coke and patent fuel to operate from the 22nd inst., recently announced by the railway companies, form a step in the right direction, more especially as the concession has been made in the flat rate, but so far as South Wales is concerned, it is quite inadequate to meet the necessities of the coal trade. The secretary of the South Wales Coalowners' Association states that the need exists for a drastic reduction in railway and dock charges. The South Wales district as a whole has had less benefit from the reductions in railway rates than any other district. A concession that would be of real value would have been the abolition of the whole of the flat rate, for it is the incidence of that flat rate which has had the effect of imposing a higher percentage increase in railway rates in South Wales than in any other districts. As there is a prospect of an early meeting between the representatives of the Bristol Channel Dockowners' Association and the representatives of the Traders' General Committee, Mr. Finlay Gibson, the secretary of the latter body, has forwarded to the chairman of the Dockowners' Association a letter giving facts and reasons in support of their application for an immediate further reduction in dock charges. This letter states that both the coal and shipping industries for some months past have been, and are still, in a very serious financial position, and both coalowners and shipowners have had to make very heavy sacrifices in order to regain the export trade of South Wales, which sacrifices have been of enormous benefit to the railway and dock companies, as the latter have had the revenue from the increased volume of trade. Details are set forth as to the increase of trade and a comparison is made with the charges for shipping in the North, and it is urged that the question, both of railway and dock charges, should be discussed and settled in the districts, and not nationally, and that local companies should not be restricted by the views of dock companies in other districts.

Steel Production.

The announcement is made that experiments by the Ebbw Vale Company to enable it to make use of the iron ore from its own mines at Irthlingborough, Northamptonshire, have proved highly successful. The process which has been tested is not a new one, but a modification of an old one, and is technically known as the Duplex system of using the old Bessemer basic process. It has been adopted for some years in the United States, and it is stated that it is only economical where a big turn-out is sought to be obtained. The Ebbw Vale Company is the pioneer of the Duplex system in this country, and it is understood that its experiments are being followed with considerable interest by other steelmakers in this country. The Ebbw Vale Company acquired the iron ore area in Northamptonshire before the war, but the change in the system of steel manufacture was held up in consequence of hostilities. Hopes are entertained that it will mean a revival in the steel industry of this district.

Current Business.

The volume of fresh business on the coal market for steam qualities is rather limited, but the tone is well maintained by reason of the orders which coalowners have on their books. As a matter of fact, many collieries are now very well placed until close on the middle of next month, so that no early or material reduction in prices can be looked for. As regards the anthracite section, prices, with a few exceptions, are firmer, best quality large being quoted at round about 50s., with machine-made nuts at 50s., and cobbles at 55s., these prices being for early June loading, although for very prompt shipment they can be discounted. Owners will not sell for very far ahead, as they appear fully convinced that values will go still higher.

Latest News from the Provinces.

WALES AND ADJOINING COUNTIES.

Italian Coal Inquiry.

IT appears that the inquiry for about half a million tons of steam coal for delivery over twelve months, and referred to in this week's letter, is not for account of the Italian Government, but for one of the largest Italian shipping companies, which, before the war, was regularly a large purchaser of coal from this district.

Swansea Metal Exchange.

New business being quieter, the tin-plate trade is not so good, and prices have given way slightly to 19s. 3d. to 19s. 6d. basis I.C. f.o.b. for prompt supplies.

NATURAL GAS SUPPLY IN FRANCE.

IN September last, a company, organised for the purpose of boring for petroleum in France, ascertained the presence, 500 m. below the surface, of large quantities of natural gas, in the Valley of Vaux Fevroux (Ain). A large tube was sunk into the boring, and the natural gas rose to the surface at a pressure of 15 kilos. per square centimetre. The supply has remained constant since September, and the volume of gas which escapes each time the subterranean "gas-holder" is opened exceeds 100,000 cubic metres. As this gas closely resembles artificial lighting gas, has twice the heating power, and is entirely free from carbonic oxide, it was at once proposed to turn the supply to a useful purpose. The Municipality of Amberieu has signed a contract with the company, by the terms of which the gas, after it has been purified, will be taken through a pipe 8 kiloms. long to the town of Amberieu. The supply is to be not less than 10,000 cubic metres per day, and will be available to the general public at the very reasonable rate of 35 centimes per cubic metre. The Municipality of Lyons, 50 kiloms. from the natural gasometer, is also considering the possibility of utilising the gas from Vaux Fevroux.

THE five hundred pounds presented to Mr. G. J. Churchward by his colleagues on his retirement are, at his request, to be invested, and the interest accruing is to be spent on prizes for Great Western Railway students at technical schools.

Catalogues.

ALBERT MORGAN, 138, Gower-street, W.C. 1.—Illustrated booklet of machinery which Mr. Morgan is able to supply immediately.

GEO. NOBBS, Limited, 89, Cleveland-street, Fitzroy-square, London, W. 1.—Leaflet Y209 illustrates and describes the "Genii Neptune" electric hot-water radiators for marine and land work.

THE LANCASHIRE UNITED TRAMWAYS, Limited, Atherton Liverpool and Manchester.—A copy of the firm's publication, entitled "Touring by Motor Coach" for the 1922 season. It may be obtained at the price of 1s.

F. A. HUGHES AND CO., Limited, 1 and 3, Regent-street, S.W. 1.—A copy of a new pamphlet just issued on "Electron Metal." The metal, which is approximately half the weight of aluminium, may be used for castings, extruded sections, rods, sheets and stampings.

FRANCIS MORTON AND CO., Limited, Hamilton Ironworks, Garston, Liverpool.—A copy of new catalogue on iron castings. Many of the large castings executed by the firm are illustrated. Besides general cast iron work of every description, the firm specialises in chemical plant.

NATIONAL BOILER AND GENERAL INSURANCE COMPANY, Limited, Manchester.—A list of boiler fittings and articles useful to steam users and engineers, which may be obtained from the sales department of the company. In most cases an illustration of the fitting is given.

MARSHALL, SONS AND CO., Limited, Britannia Ironworks, Gainsborough.—Publication No. 1250 on horizontal engines, Class "K" series, has been received. Besides an article on "Selecting an Engine," general specifications with illustrations of the engines have been embodied.

ROBERTS, GLAZEBROOK AND CO., Limited, Cobden Works, Gower-street, Birmingham.—A copy of a little pamphlet on "Carbolastic Paint" for the protection of iron and steel structures. These paints prevent rust and corrosion. Sample reproductions of the colours supplied are given in the pamphlet.

PLENTY AND SON, Limited, Newbury.—A copy of the firm's publication *Oil Power* for February. This issue contains an article on "Oil-burning for Locomotives." The Scarab patent locomotive type burner is described. An article, entitled "The Installation and Running of Plenty Heavy Marine Oil Engines," is continued in this issue.

SERCK RADIATORS, Limited, Warwick-road, Greet, Birmingham.—An illustrated pamphlet on oil coolers (Zimmermann patent) for re-cooling oil in turbine bearings, electric transformers, internal combustion engines, steel quenching tanks and recovery plants. Diagrams and illustrations of plants in operation are given.

HOLLINGS AND GUEST, Limited, Thimble Mill-lane, Birmingham.—A copy of the firm's latest catalogue on hydraulic presses and screw presses. Amongst recent sales, over twenty important firms have been supplied with hydraulic tire presses and pumps. A range of sizes of from 50 tons to 200 tons pressure are manufactured.

MANLOVE, ALLIOTT AND CO., Limited, Bloomsgrove Works, Nottingham.—A copy of steam disinfector catalogue No. 650A. These steam disinfectors are manufactured for high-pressure steam, under Alliott and Paton's patents. Many illustrations have been included of the machines, and much useful information on disinfection is embodied in the catalogue.

SCHULZE AND CO., Leipzig 36.—A compilation has been received from this firm which is called a "directory of directories." About thirty-four pages are covered in giving particulars of directories, but unfortunately the name of the publisher of each different one is omitted, thereby causing delay to anyone wishing to obtain a copy at short notice.

SIMPLEX CONDUITS, Limited, Garrison-lane, Birmingham.—New list No. 917, in connection with the "Terra Grip" continuity system for light gauge unscrewed conduit installations for either light or power. Many installations of this system have been put into service, and have proved their utility. Illustrations of the different types are included with prices.

THE NATIONAL GAS ENGINE COMPANY, Limited, Ashton-under-Lyne.—A copy of this firm's catalogue has been received. It is entitled "National Gas Engine Installations will Save You Thousands of Pounds Yearly." Besides descriptive matter, many good illustrations of actual installations have been reproduced. The catalogue has been produced on a two-colour scheme and proves very effective.

THE PARSONS MOTOR COMPANY, Limited, Town Quay Works, Southampton.—A copy of the firm's new industrial installation book is to hand. A varied collection of illustrations and designs is given, in which Parsons engines are shown incorporated in stationary and portable plants. At the end of this exceedingly well-produced book, some examples of lay-out drawings will prove of interest to those engaged in power station work.

NOBEL INDUSTRIES, Limited, Nobel House, Buckingham Gate, S.W. 1.—A new booklet has been issued by this company, and affords a comprehensive review of the Nobel Industries products. In addition to a list of names of companies which form the amalgamation, air photographs are given of several factories, and explanatory notes concerning the products form an interesting survey. A copy of this booklet may be obtained on application to the company.

SIEMENS BROTHERS AND CO., Limited, Woolwich, S.E. 18.—Pamphlet No. 1307, which has just been received, treats with "Electric Supply and Housing Schemes: The 'Stannos' Concentric System of Main Distribution." This system has been adopted in a great number of housing schemes now in progress, and a general description is supplied, with illustrations of contracts carried out. Copies may be obtained of this pamphlet on application to the company.

MELDRUMS, Limited, Timperley, near Manchester.—A copy of a new list concerning mechanical stokers. In the brief description, much useful information gained from practical and experimental work is given. Photographs of stokers and diagrams are embodied in the pamphlet, whilst an installation in colours is reproduced. An illustrated pamphlet on "Forced Draught Furnaces." The "Meldrum" furnace was invented in the year 1887. Since that time nearly 18,000 furnaces have been fitted representing a steam production of nearly 2½ million horse-power. The pamphlet tells what "forced draught is," and a list of advantages of this system is given.

TROST BROTHERS, 26, Little Park-street, Coventry.—We have received a copy of the Rotameter booklet. This machine is an instrument for measuring the flow of gases and liquids. Rotameters are direct reading, sensitive and accurate. They have no mechanism to get out of order, and can be used for oils, for acids, alkalies and other corrosives. Among numerous uses are—measuring and regulation of rate of flow of gases and liquids in distillation, absorption, reaction, mixing; measuring the consumption of air in compressed air tools, of gas in burners, stoves, engines, petrol and fuel oil consumption in internal combustion engines; correct proportion of gas mixture in oxy-acetylene welding. In laboratory and research work the instruments are supplied to give accurate readings down to one-hundredth of a cubic foot per hour, and for industrial uses up to 100,000 cubic feet per hour. The scale can be graduated to read in cubic feet, gallons, litres, pounds per hour or per minute; pressures up to 120 lb. per square inch and temperatures up to 220 deg. Cent. can be dealt with.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
Native	28/-
(1) Spanish	28/-
(1) N. African	28/-
N.E. COAST—	
Native	—
Foreign (c.i.f.)	27/-

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(3) SCOTLAND—		
Hematite	5 5 0	—
No. 1 Foundry	4 17 6	—
No. 3 ,,	4 12 6	—
N.E. COAST—		
Hematite Mixed Nos.	4 16 0	4 15 0
No. 1	4 17 0	4 16 0
Cleveland—		
No. 1	4 15 0	4 15 0
Silicious Iron	4 15 0	4 15 0
No. 3 G.M.B.	4 10 0	4 10 0
No. 4 Foundry	4 7 6	4 7 6
No. 4 Forge	4 5 0	4 5 0
Mottled	4 0 0	4 0 0
White	4 0 0	4 0 0
MIDLANDS.		
(3) Staffs.—		
All-mine (Cold Blast)	13 0 0	—
Part Mine Forge	*None offering.*	
North Staffs. No. 3 F'dry	4 5 0 to 4 10 0	
(3) Northampton—		
Foundry Nos. 2 and 1	*Nominal.*	
,, No. 3	4 0 0	—
,, Forge	3 10 0 to 3 12 6	
(3) Derbyshire—		
No. 3 Foundry	4 2 6 to 4 5 0	
Forge	3 12 6 to 3 15 0	
(3) Lincolnshire—		
Basic	4 0 0 to 4 5 0	
Foundry	4 5 0 to 4 10 0	
Forge	4 2 6 to 4 5 0	
(4) N.W. COAST—		
N. Lancs. and Cum.		
Hematite Mixed Nos.	5 15 0	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	11 0 0	10 15 0
Best ,,	12 0 0	—
N.E. COAST—		
Crown Bars	12 0 0	—
Tees	14 10 0	—
LANCS.—		
Crown Bars	11 10 0	—
Hoops	14 0 0	13 15 0
S. YORKS.—		
Crown Bars	12 0 0	—
Best ,,	13 0 0	—
Hoops	14 0 0	—
MIDLANDS—		
Marked Bars (Staffs.)	13 10 0	—
Crown Bars	11 10 0	—
Nut and Bolt Bars	10 5 0	—
Gas Tube Strip	11 10 0 to 11 15 0	
Hoops (*Nom.*)	14 0 0	—

STEEL.

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates	14 0 0	—
Ship Plates ⅜in. and up	10 10 0	—
Sections	10 0 0	—
Steel Sheets ¼in. to ⅜in.	11 15 0	—
Sheets (Gal. Cor. 24 B.G.)	—	16 5 0

STEEL (*continued*)

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	10 10 0	—
Angles	10 0 0	—
Boiler Plates	14 10 0	—
Joists	10 10 0	—
Heavy Rails	9 10 0	—
Fish-plates	14 10 0	—
Channels	14 10 0	—
Hard Billets	8 15 0	—
Soft Billets	7 15 0	—
N.W. COAST—		
BARROW—		
Heavy Rails	9 10 0	—
Light ,,	11 0 0 to 13 0 0	
Billets	9 5 0	—
Ship Plates	10 10 0	—
Boiler ,,	14 10 0	—
MANCHESTER—		
Bars (Round)	10 0 0 to 12 0 0	
,, (others)	11 0 0 to 12 0 0	
Hoops (Best)	15 5 0	15 0 0
,, (Soft Steel)	12 5 0	12 0 0
Plates	£10 to 12	10 0 0
,, (Lancs. Boiler)	16 0 0	—
SHEFFIELD—		
Siemens Acid Billets	10 0 0 to 11 0 0	
Bessemer Billets	12 10 0	—
Hard Basic ,,	9 5 0	—
Soft ,,	7 15 0	—
Hoops	12 5 0	—
Soft Wire Rods	11 0 0	—
MIDLANDS—		
Small Rolled Bars	9 5 0 to 9 10 0	
Bessemer Billets	7 12 6	—
Hoops	11 15 0 to 12 0 0	
Gas Tube Strip	10 5 0 to 10 10 0	
Sheets (24 W.G.)	11 10 0 to 12 0 0	
Galv. Sheets (f.o.b. L'pool)	16 0 0 to 16 10 0	
Angles	10 0 0	—
Joists	10 10 0	—
Tees	11 0 0	—
Bridge and Tank Plates	10 10 0	—

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14	19/3 to 19/6
Block Tin (cash)	148 5 0
,, (three months)	149 15 0
Copper (cash)	60 10 0
,, (three months)	60 16 3
Spanish Lead (cash)	24 0 0
,, (three months)	22 15 0
Spelter (cash)	26 17 6
,, (three months)	26 15 0
MANCHESTER—	
Copper, Best Selected Ingots	65 10 0
,, Electrolytic	67 10 0
,, Strong Sheets	88 0 0
,, Loco Tubes	0 1 1½
Brass Loco Tubes	0 0 11½
,, Condenser	0 1 2½
Lead, English	25 10 0
,, Foreign	24 10 0

FERRO ALLOYS,

(*All prices now nominal*).

	Per Ton.	Per Unit
Tungsten Metal Powder	1/6 per lb.	
Ferro Tungsten	1 4 per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£27	10/-
,, 6 p.c. to 8 p.c. ,,	£26 10 0	9/-
,, 8 p.c. to 10 p.c. ,,	£25 10 0	8/-
,, Specially Refined ...		
Max. 2 p.c. carbon	£70	28/-
,, 1 p.c. ,,	£88	30/-
,, 0·75 p.c. carbon	£103	37/-
,, carbon free	2/- per lb.	
Metallic Chromium	5/3 per lb.	
Ferro Manganese (per ton)	£15 for home.	
,, Silicon, 45 p.c. to 50 p.c.	£13 0 0 scale 5/- per unit	
,, ,, 75 p.c.	£25 10 0 scale 6/- per unit	
,, Vanadium	20/- per lb.	
,, Molybdenum	7/- per lb.	
,, Titanium (carbon free)	1/3 per lb.	
Nickel (per ton)	£180	
Cobalt	14 - per lb.	
Aluminium (per ton)	£110 to £120 (British Official).	

FUELS.

	Export.
SCOTLAND.	
LANARKSHIRE—	
(f.o.b. Glasgow)—Steam	20/6
,, ,, Ell	20/6
,, ,, Splint	21/6 to 23/6
,, ,, Trebles	19/-
,, ,, Doubles	18/-
,, ,, Singles	17/-
AYRSHIRE—	
(f.o.b. Ports)—Steam	20/-
,, ,, Splint	21/6
,, ,, Trebles	19/-
FIFESHIRE—	
(f.o.b. Methil or Burntisland)—Steam	18/- to 22/-
Screened Navigation	27/-
Trebles	19/6
Doubles	18/6
Singles	18/-
LOTHIANS—	
(f.o.b. Leith)—Best Steam	20/-
Secondary Steam	19/6
Trebles	19/6
Doubles	18/6
Singles	17/6
ENGLAND.	
(8) N.W. COAST—	
Steams	33/-
Household	40/- to 55/-
Coke	34/-
NORTHUMBERLAND—	
Best Steams	22/6 to 24/-
Second Steams	21/6 to 22/-
Steam Smalls	13/- to 15/-
Unscreened	20/6
Household	25/- to 30/-
DURHAM—	
Best Gas	23/- to 23/6
Second	21/- to 22/-
Household	25/- to 30/-
Foundry Coke	32/6 to 35/-
SHEFFIELD—	**INLAND.**
S. Yorks. Best Steam Hards	22/- to 23/- —
Derbyshire Hards	21/- to 22/- —
Seconds	20/- to 21/- —
Cobbles	20/- to 21/- —
Nuts	18/- to 19/- —
Washed Smalls	11/- to 12/- —
Best Hard Slacks	12/- to 13/- —
Seconds ,,	10/- to 11/- —
Soft Nutty ,,	7/6 to 8 6 —
Pea ,,	7/- to 8/- —
Small ,,	2/- to 4 6 —
House, Branch	37/- to 39/- —
,, Best Silkstone	33/- to 35/- —
Blast Furnace Coke (Inland and Export)	19/- to 21/-

(9) SOUTH WALES.

CARDIFF—	
Steam Coals:	
Best Smokeless Large	28/6
Second ,, ,,	28/-
Best Dry Large	26/6 to 27/6
Ordinary Dry Large	25/- to 25/6
Best Black Vein Large	27/- to 27/6
Western Valley ,,	26/6 to 27/-
Best Eastern Valley Large	26/6 to 27/-
Ordinary ,, ,,	24/6 to 25/6
Best Steam Smalls	19/- to 20/-
Ordinary ,,	15/- to 19/-
Washed Nuts	25/- to 27/6
No. 3 Rhondda Large	28/- to 30/-
,, ,, Smalls	19/6 to 20/-
No. 2 ,, Large	23/- to 24/-
,, ,, Through	19/- to 20/-
,, ,, Smalls	15/- to 16/-
Coke (export)	34/- to 35/-
Patent Fuel	25 6 to 28 6
Pitwood (ex ship)	31 6 to 32 6
SWANSEA—	
Anthracite Coals:	
Best Large	45/- to 50/-
Seconds	40/- to 42 6
Red Vein	30/- to 32 6
Big Vein	40/- to 45/-
Machine-made Cobbles	50/- to 52/6
Nuts	50/- to 52 6
Beans	45/- to 50/-
Peas	24/- to 26/-
Breaker Duff	10/- to 10/6
Rubbly Culm	16 6 to 17/-
Steam Coals:	
Large	22/6 to 24/6
Seconds	20/- to 22 6
Smalls	14/- to 16/-
Cargo Through	18/- to 20/-

(1) Delivered. (2) Net Makers' works. (3) At furnaces. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire.

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/- extra delivered England. (7) Export Prices—F.O.B. Glasgow.

(8) Except where otherwise indicated coals are per ton at pit for inland and f.o.b. for export and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b.

French Engineering Notes.

(From our Correspondent in Paris.)

The Paris Fair.

THE annual Fair in Paris offers a good opportunity of gauging the tendencies of the French engineering industries. It is the only purely national exhibition from which foreign products are rigorously excluded. The series of Paris Fairs was inaugurated at a time when a certain amount of propaganda work was being carried out in favour of encouraging home manufactures, and the policy pursued since then of producing everything possible in the country has been strengthened by the belief that the purchase of French instead of foreign goods will help to improve the present precarious financial situation. The Fair is consequently a manifestation of industrial protection which is receiving considerable support from manufacturers, who believe that they are unable to do without it and, to a lesser extent, from the public which is under the impression that the financial position can only be improved by a development of the home industries. On the other hand, there is a growing class of consumers who see that the policy of protection can have no other effect than to increase prices on the home market, while experience has already shown that it has a disastrous effect upon the foreign trade in such purely French products as silks and wines. The exclusive policy now being pursued has also given rise to international complications which can only be removed by concessions in favour of certain foreign products. The matter is now being seriously investigated by the Government, which is endeavouring to compromise between the desire of manufacturers to be protected by higher tariffs, and the obvious political and economical necessity of giving at least partial satisfaction to countries that have retaliated against the French fiscal measures. Meanwhile, manufacturers have been giving more and more support to the national Paris Fair, which last week had to find accommodation for the largest number of exhibitors yet brought together, to the extent that the whole of the space available on the Champ de Mars was reserved for mechanical and electrical engineering and agricultural machinery. It was noteworthy that some of the big firms which on previous occasions had "pavilions" of their own, were conspicuous by their absence, and the Fair was mostly supported by local manufacturers and by a large number of new makers and provincial firms, the lengthening list of which is evidence of the rapid growth of the engineering industry.

Machinery Exhibits.

The machine tool branch of the industry was particularly well represented on the Champ de Mars. Several firms, which have always been associated with other manufactures, have, it was seen, turned their attention to metal working machinery, and as the older makers are constantly adding to the types of machine tools manufactured, the total productive capacity must now be large. Except for light automatic lathes and a few special machines, all the lathes, milling, shaping, planing and slotting machines were of standard patterns, and, so far, the French industry seems to be following general practice instead of trying to improve on existing types of machines. In nearly all cases the manufacture is creditable. Some particularly heavy lathes and drilling machines were constructed in the works formerly owned by Bouhey et Cie., and now forming part of the Schneider combination under the name of S.O.M.U.A. Since the absorption of the Bouhey works in the group a few years ago, the construction of machine tools has undergone a considerable extension. Woodworking machinery has also made rapid strides on account of the increasing demand for such machines, due partly to the development of the colonial timber resources. As was the case with metal-working machinery, however, there was nothing exhibited out of the common, and there was little to be seen beyond sawing, planing, tenoning and morticing machines. There were several portable reciprocating and circular sawing machines with electric motors or petrol engines. In the heavier branches cranes constituted a special feature, and one of the most interesting exhibits was that of the Ateliers et Chantiers de Bretagne of Nantes, which showed a crane with suction gas power plant. Much attention is given in France just now to suction gas plants for tractors and other vehicles as well as for elevating and machinery to be used in the colonies where charcoal is often the only form of fuel available.

The Rhine.

Having pushed her frontier forward through Alsace to the Rhine, France obtained the right, under the Treaty of Versailles, to divert water from the river for feeding the canals and for irrigation purposes and to construct barrages for the production of hydraulic power. Plans were immediately drawn up for a series of works between Basle and Strasburg, including a barrage at Huningen and a lateral canal, 116 kiloms. long, with eight falls of 10 m. to 12 m. The width of the canal was to be 20 m. and the energy produced was estimated to be from 800,000 to 1,000,000 horse-power. The project, however, aroused a good deal of opposition from other countries, where it was feared that the diversion of so large a volume of water would seriously affect the navigation, and as one object of the French scheme was to permit of the passage of barges of 1200 tons along the lateral canal, another project was presented for obtaining the same result by deepening the Rhine itself. This was objected to by the French, who would thus be deprived of the hydraulic power, and the original scheme has therefore been modified whereby the position of the barrage has been changed so as to reduce the velocity of the current. As the Central Commission of the Rhine is of the opinion that the modified scheme will not affect the conditions of navigation there is every probability of its being accepted. Meanwhile, a company is being formed under the name of the Compagnie Nationale du Rhin Français to carry out the work with the aid of the Chambers of Commerce of all the towns that will be interested in the execution of the scheme, either from the point of view of navigation or of electrical distribution.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

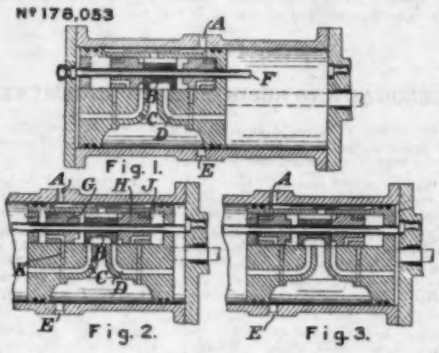
Copies of Specifications may be obtained at the Patent Office Sale Branch, 25, Southampton buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

STEAM ENGINES.

178,053. February 25th, 1922.—A RECIPROCATING STEAM ENGINE, C. W. A. Taylor, Sunville, Corbridge-on-Tyne.

THE action of the valve gear of this engine is as follows:—Steam, admitted at A, is permitted by the valve B to enter a port C leading to the left-hand end of the cylinder, and steam is permitted to exhaust through a port D leading from the other end of the cylinder into a lateral exhaust port E. This piston moves until the rod F is arrested by engagement with the end of the cylinder, as shown in Fig. 2, whereupon the supplementary

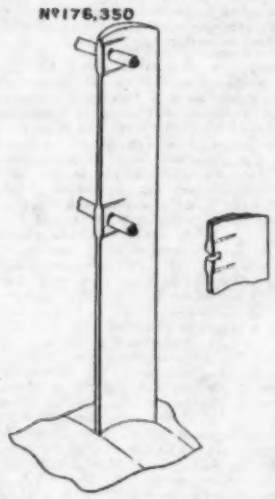


pistons G H and therewith the valve B are moved relatively to the piston, so that a steam inlet port J is unmasked by the piston H, and steam is admitted to the end of the supplementary cylinder, while steam is exhausted by way of a port K from the other end. The valve B is thus moved until port C is brought into communication with the exhaust, and the port D into communication with the steam supply. Fig. 3 shows the relative positions of the parts for the return stroke.—*April 13th*, 1922.

TURBINE MACHINERY.

176,350. February 23rd, 1922.—TURBINE BLADES, Metropolitan-Vickers Electrical Company, Limited, 4, Central-buildings, Westminster, assignees of Francis Hodgkinson, of 302, North Chester-road, Swarthmore, Pennsylvania.

The inventor thickens up steam turbine blades, as shown in the illustration, where they are pierced for the accommodation of the bracing, in order that the moment of resistance of the

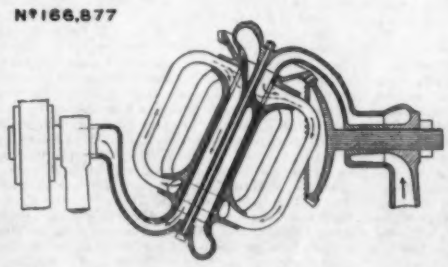


blade section where the slot or perforation occurs will not be less than that of any other portion of the blade. The thickening is, however, not so great as to cause adjacent blades to touch at that place.—*April 13th*, 1922.

PUMPING AND BLOWING MACHINERY.

166,877. March 21st, 1921.—A GYROSCOPIC PUMP, E. Faure, No. 34, Rue du Colisée, Paris.

The inventor claims that the precessional force of a gyroscope

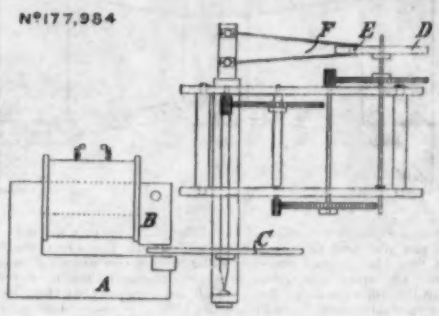


is utilised, in this machine, to produce a difference in pressure in the liquid between the inlet and outlet. It will be seen that the impeller takes the form of a cage of pipes, which is rotated about two axes. The secondary axis forms a valve, which acts like the commutator of a dynamo, to maintain the direction of flow, which is indicated by the arrows.—*April 13th*, 1922.

SWITCHGEAR.

177,984. March 23rd, 1921.—AUTOMATIC ELECTRIC TIME SWITCH, Arthur Joseph Wheeler, of 71, Mortimer-road Kensal Rise, N.W. 10.

The time switch described in this specification is actuated by a constant speed electric motor A, which consists of a coil, which is energised with alternating current. The magnetic flux from the core B acts on a copper band underneath the disc

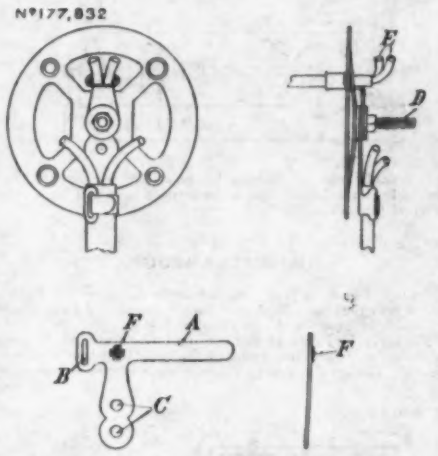


C. This disc drives an insulated disc D through a train of gearing. A silver pin E protrudes a little above the top and bottom surfaces of this disc, so that as the latter revolves a circuit is completed between the brushes F at definite intervals.—*April 13th*, 1922.

LIGHTING AND HEATING.

177,832. November 20th, 1920.—IMPROVEMENTS IN MEANS FOR BONDING THE METALLIC SHEATHS OF ELECTRICAL CONDUCTORS, Max John Railing, Frank Gordon Quance, and Herbert Victor Owen, of 67, Queen Victoria-street.

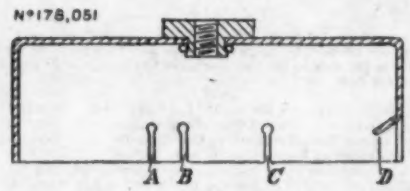
For bonding the sheathing of conductors in accordance with this invention, a soft metal tee-shaped bonding clip A is used. At one end of this clip is a slot B, and when the clip has been folded round the sheathing the opposite end of the clip is passed through the slot. The vertical part of the clip is provided with holes C, through one of which the projecting screwed part of a terminal D passes, and the clip is clamped in position by means



of a nut as shown. Any number of cables entering a fitting may be provided with these clips, so that their sheathings may be bonded together. The conductors of several cables—as shown, for example, at E—may be joined up to the fitting to form the necessary circuits by connections in the usual manner. In the upper illustrations two cables are shown associated with the back plate, the lower cable entering at the side of the fitting and the upper cable at the back. Small holes punched at the point F serve to increase the gripping property of the clip.—*March 29th*, 1922.

178,051. November 29th, 1920.—IMPROVEMENTS IN ELECTRIC JUNCTION BOXES AND THE LIKE, Max John Railing, Frank Gordon Quance and Herbert Victor Owen, all of 67, Queen Victoria-street, London, E.C.4.

According to this invention, sheet metal covers of junction boxes and other fittings associated with electric wiring systems are provided with slits, as shown at A, B, C and D. In order to provide an entry for a lead at the required point, it is merely



necessary to bend the portion of metal between any desired pair of slits inwards and at approximately right angles to the side of the cover. In this way openings for leads of various sizes can be made without trouble, for it will be noticed that the slits are not equally spaced. The inwardly projecting tongues may also be made to press on to the sheathing of the leads in order to earth the metal cover.—*March 29th*, 1922.

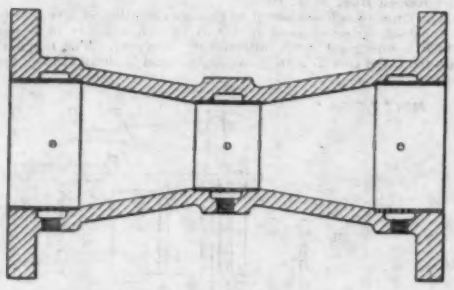
MEASURING AND TESTING INSTRUMENTS.

178,010. April 27th, 1921.—WATER METERS, W. G. Kent and E. W. Hovenden, 199, High Holborn, London, W.C. 1.

This invention relates to improvements in fluid meters in which there is inserted in the pipe conveying the fluid to be measured a tube which is tapered in both directions, so as to

form at or near the middle of its length a constriction or throat, the flow through the tube being measured by means of the difference between the pressure at the inlet or up-stream end of the tube and the pressure at the throat. The inventors provide an additional vent at the outlet or down-stream end of the tube, and obtain a measure of the flow by means of the overall

N°178,010



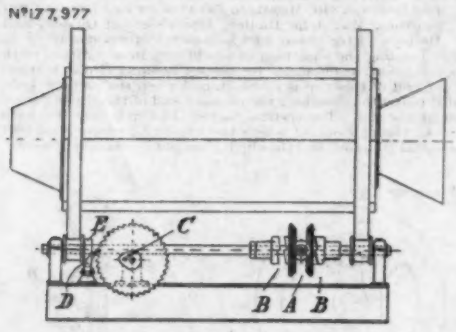
pressure difference, that is, the difference between the pressure at the inlet and the pressure at the outlet. For any given rate of flow this overall pressure difference is considerably smaller than the up-stream throat pressure difference, and is therefore suitable for measuring flows which are so great that they set up an inconveniently high up-stream throat pressure difference.—*April 13th*, 1922.

BUILDING.

177,977. March 16th, 1921.—CONCRETE MIXERS, J. Southall, Worcester Foundry, Worcester.

This concrete mixer has a barrel which is corrugated longitudinally, to improve its mixing effect, and is rotated intermittently in opposite directions by the gearing A. The clutches

N°177,977



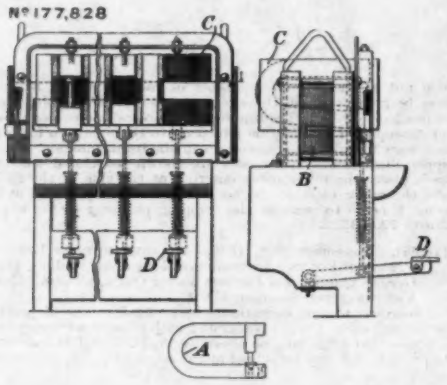
B B are alternately engaged by means of a crank C that is driven by a ratchet D, which, in turn, is operated by a cam E.—*April 13th*, 1922.

MISCELLANEOUS.

177,828. October 29th, 1920.—IMPROVEMENTS IN ELECTRIC RIVET HEATERS, William Smith Johnson and John Westley, both of Berwick, Pennsylvania, U.S.A.

The secondary coils of the welding transformer are U-shaped, as shown at A, and the spring of the arms is utilised to hold the rivets. The core B passes through each of the secondaries A.

N°177,828



Primary coils are arranged—as shown, for example, at C. The rivets are released by pressing foot pedals D, which are attached by means of rods to the lower arms of the secondary members A.—*March 29th*, 1922.

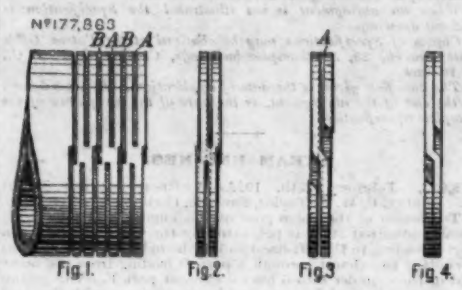
170,575. October 12th, 1921.—IMPROVED PROCESS AND APPARATUS FOR PURIFYING GASES BY ELECTRICITY, Siemens-Schuckertwerke Gesellschaft mit Beschränkter Haftung, of Siemensstadt, near Berlin.

This invention is very inadequately described, and there are no illustrations. It is known, the specification states, that in electrical apparatus for precipitating dust from gases by bringing the gases into contact with electrically charged electrodes, either alternating or direct current may be employed, but different materials are not always separated equally well with both kinds of current. According to the invention, the precipitation apparatus is constructed so that the particles that are separated in the two fields which are produced by the direct and alternating current can be collected and removed separately from each other. The solid particles are separated in the direct current field, whilst the liquid is separated in the alternating current field. In all other respects, it is stated, the improved precipitation apparatus may be constructed in any suitable manner.—*April 13th*, 1922.

177,863. January 3rd, 1921.—PISTON RINGS, B. Clews, 37A, Agamemnon-road, West Hampstead, and H. M. Petersen, 46, King's-road, Willesden Green.

The inventors make piston rings by cutting spiral grooves nearly through a cast iron cylinder. The alternate grooves A A do not go quite round, while the intervening ones B B make more than a complete circle. The interior of the cylinder is then bored out, and the rings part off, as shown in Fig. 2. They are gapped as indicated in Fig. 3, and are then turned inside out

N°177,863



and stretched, so as to give them a permanent set and close up the opening left by the groove A—see Fig. 3—when they are turned back again and appear as in Fig. 4.—*April 3rd*, 1922.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

MR. JAMES TEABOE, M. Inst. C.E., M.I. Mech. E., has resigned his position as Executive Engineer to the Queensland Government, having completed upwards of forty years' service.

WE are asked to state that Sir Richard Gregory, F.R.A.S., F. Inst. P., has accepted the position of president of the Decimal Association, in succession to the late Lord Belhaven and Stenton.

ALFRED HERBERT, Limited, of Coventry, inform us that they have now opened their own office in Buenos Aires at 25, de Mayo, No. 267. It will be in the charge of Mr. Colin York. In addition to carrying on their own particular business, Messrs. Herbert will also act as representatives for well-known British manufacturers.

THE WAYNE ENGINEERING AND EQUIPMENT COMPANY, Limited, the head office of which is at Kingsway Chambers, 44–46, Kingsway, London, W.C. 2, has opened branch offices as follows:—The Efandem Company, Limited, 28, Queen-street, Albert-square, Manchester; Astbury and Madeley, Empire House, Great Charles-street, Birmingham; W. Anderson Penman, 36, Exchange-street, Norwich; G. F. French, Kent Works, Kendal; Douglas G. Cochrane and Co., Limited, Princes Buildings, 11, Akenside-hill, Newcastle-on-Tyne; and Philip and Bruce, Limited, 50, Wellington-street, Glasgow.

CRYSTAL PALACE OLD STUDENTS' SOCIETY.—Many well-known engineers were present at the twenty-first annual dinner of the Crystal Palace Old Students' Society, which took place at the Hotel Rubens, Buckingham Palace-road, on May 10th, and which was held partly in order to celebrate the fiftieth year of the Crystal Palace School of Practical Engineering. Major-General Sir George Scott-Moncrieff, who, as Director of Fortifications and Works, employed during the war a larger number of civil engineers than have ever before worked under a single chief, was the principal guest. In wishing success to the School, he expressed a decidedly optimistic outlook with regard to the future, agreeing strongly with the recent speech made by his countryman, Sir James Barrie.

THE INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—The forty-ninth annual general meeting and conference of the Institution of Municipal and County Engineers, including a town-planning exhibition and trials of municipal appliances, will be held at the City Hall, Cardiff, on Wednesday, Thursday, Friday, and Saturday, June 21st, 22nd, 23rd, and 24th next. The following is a list of the papers to be discussed at the conference. They will be taken, as far as possible, in the order indicated, but the sequence may be varied at the discretion of the president. (1) "Town-planning and Re-planning in Great Britain," by Mr. H. H. Humphries, M. Inst. C.E., city engineer Birmingham; (2) "Town-planning and Re-planning Abroad," by Mr. Thomas Adams, town-planning adviser, Commission of Conservation, Canada; (3) "The Mechanical Equipment of a Municipal Works Depôt and Scavenging and Cleansing Department," by Mr. F. Wilkinson, M. Inst. C.E., engineer and surveyor, Willesden Urban District Council; (4) "The Mechanical Equipment of a Highways Department," by Mr. A. Dryland, M. Inst. C.E., county engineer, Middlesex; (5) "Mechanical Transport," by Mr. Thomas Molyneux, M.I. Mech. E., chief mechanical engineering assistant, City Engineer's Department, Liverpool; (5a) "Electric Vehicles for Municipal Work," by Mr. R. B Mitchell, electrical engineer to the Glasgow Corporation; (6) "Heavy Oil Fuel Lorries for Refuse Collection," by Mr. G. Bertram Hartfree, F.S.I., borough surveyor and engineer, Godalming; (7) "The Mechanical Equipment of Waterworks," by Mr. G. R. Collinson, B.Sc., A.M. Inst. C.E., water engineer, Swansea Corporation; (8) "Cardiff Housing Schemes—Organisation and Realisation," by Mr. B. Price Davies, M.S.A., chief assistant, Housing Department, Cardiff; and (9) "City of Cardiff Waterworks, Taff Fawr Section, Breconshire," description by Mr. C. H. Priestley, M. Inst. C.E., waterworks engineer and engineer-in-chief new works. On the morning of Wednesday, June 21st, at 11.30 a.m., visitors and delegates will be welcomed by the Lord Mayor of Cardiff, Councillor Francis Harold Turnbull, J.P., and Mr. E. J. Elford, M.Inst. C.E., M.I. Mech. E., city engineer and architect, Cardiff, will be installed as president and deliver his presidential address. In the afternoon, at 2.15 p.m., addresses will be delivered by Sir Henry P. Maybury, K.C.M.G., C.B., Director-General, Roads Department, Ministry of Transport, and by Mr. J. G. Gibbon, Assistant Secretary, Ministry of Health. Papers 1 and 2 will then be discussed. In the evening, at 7.30 p.m., there will be a reception by the Lord Mayor in the City Hall. On the Thursday, at 9 a.m and throughout the day, there will be trials and demonstrations of plant (mechanical sweepers, road tarring apparatus, gritters, concrete mixers, electrical vehicles, stone-breakers, &c.); kinematograph exhibitions of plant and processes in operation will be given in the Lecture Hall of the South Wales Institute of Engineers, Park-place; and a town-planning exhibition (maps, drawings, models, photographs, lantern slides, &c.) at the City Hall (Museum Exhibition Room, West Entrance), by permission of the Council of the Welsh National Museum. In the afternoon there will be a visit to Cardiff Castle, by permission of the Marquis of Bute. At 7.30 p.m. the annual dinner of the Institution will be held at the City Hall. On the Friday, at 10.30 a.m., discussion of papers 3 and 4 will take place, papers 5, 6, 7, and 8 being taken at the afternoon session. In the afternoon, also, there will be a garden party for ladies at the Mansion House, Richmond-road, by invitation of the Lady Mayoress; and in the evening, at 7.30 p.m., there will be a ladies' festival of the Municipal and County Engineers' Lodge, No. 3920, at the Masonic Temple, Guildford-street, Cardiff. On the Saturday, paper No. 9 will be taken and a visit paid to the new impounding reservoir in course of construction.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

JUNIOR INSTITUTION OF ENGINEERS.—Caxton Hall, Westminster, S.W. 1. Lecturette, "Engineering Business in China," by Mr. F. W. G. Clark. 8 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—Albemarle-street, Piccadilly, W. 1. Discourse, "The Structure of Organic Crystals," by Sir William Bragg. 9 p.m.

TUESDAY, MAY 23RD.

THE INSTITUTE OF PHYSICS.—Royal Society, Burlington House, Piccadilly, W. 1. Presidential address by Sir J. J. Thomson. 5 p.m.

WEDNESDAY, MAY 24TH.

ROYAL SOCIETY OF ARTS.—John-street, Adelphi, W.C. 2. "The Natural Power Resources of Ireland—Coal, Peat, Water Power," by Mr. G. Fletcher. 8 p.m.

THURSDAY, MAY 25TH.

INSTITUTION OF ELECTRICAL ENGINEERS.—Savoy-place, Victoria Embankment, W.C. 2. Annual general meeting, corporate members and associates only. 6 p.m. See page 520.

THE ILLUMINATING ENGINEERING SOCIETY.—Royal Society of Arts, John-street, Adelphi, W.C. 2. Report of the Council for the past session will be presented and the presidential address will be delivered by Sir John Herbert Parsons. 8 p.m.

FRIDAY, MAY 26TH.

THE INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—Eastern District meeting, at Town Hall, Dyne-road, Kilburn. 10.30 a.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—Albemarle-street, Piccadilly, W. 1. Discourse, "The Internal Combustion Engine: Its Influence and its Problems," by Professor W. E. Dalby, B.Sc. 9 p.m.

INSTITUTE OF METALS: NORTH-EAST COAST LOCAL SECTION.—Armstrong College, Newcastle-on-Tyne. First general meeting. Paper, "Some Problems in a Brass Foundry," by Messrs. O. Smalley and S. G. Homfray. 7.30 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—Caxton Hall, Westminster, S.W. 1. Lecturette, "Engineering Appointments and How to Get Them," by Mr. J. Cameron Rennie. 8 p.m.

ROYAL SOCIETY OF ARTS: INDIAN SECTION.—John-street, Adelphi, W.C. 2. Sir George Birdwood Memorial Lecture, "Indian Painting and Muhammadan Culture," by Sir T. W. Arnold. 4.30 p.m.

SATURDAY, MAY 27TH.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Whole-day visit of the London Graduates to the works of Cubitt's Engineering Company, Limited, Aylesbury. 8.50 a.m. train from Baker Street Station.

TUESDAY, MAY 30TH, TO FRIDAY, JUNE 2ND.

INSTITUTION OF ELECTRICAL ENGINEERS.—Summer Meeting in Scotland. Ladies invited. For programme, see page 326.

WEDNESDAY, MAY 31ST.

ROYAL AERONAUTICAL SOCIETY.—Visit to the Royal Aircraft Establishment, South Farnborough. Meet at Booking Office, Waterloo Station. 8.40 a.m.

FRIDAY, JUNE 2ND.

DIESEL ENGINE USERS' ASSOCIATION.—Institution of Electrical Engineers, Victoria Embankment. Paper, "Marine Diesel Engines," by Mr. H. F. P. Purday, B.Sc. Non-members desirous of attending the meeting can make application for tickets of admission to the hon. secretary at 19, Cadogan-gardens, S.W. 3.

SATURDAY, JUNE 3RD.

ROYAL AERONAUTICAL SOCIETY.—Visit to the National Physical Laboratory, Teddington. Meet at the booking-office, Waterloo (L. and S.W.). 9.15 a.m.

MONDAY AND TUESDAY, JUNE 5TH AND 6TH.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—Meeting of the South African District, to be held at Bloemfontein.

MONDAY TO WEDNESDAY, JUNE 19TH TO 21ST

INSTITUTE OF COST AND WORKS ACCOUNTANTS.—Sessional examinations will be held in London, Manchester, Birmingham, Sheffield, Glasgow and Bristol.

THURSDAY, JUNE 29TH.

INSTITUTION OF ELECTRICAL ENGINEERS.—Natural History Museum, S.W. Annual conversazione. 8.30 to 11 p.m.

EDUCATIONAL INTELLIGENCE.

RECENT appointments to the staff of the Technical College, Bradford, include those of Mr. R. E. Stradling, M.Sc., A.M. Inst. C.E., A.M. Amer. Soc. Eng., as Head of the Department of Civil Engineering in the College, and Mr. Henry J. B. Chapple, B.Sc. (Eng.), A.C.G.I., Whitworth Scholar, as Lecturer in Electrical Engineering.

BOROUGH POLYTECHNIC INSTITUTE.—We are informed that Mr. J. W. Bispham, M.A., B.Sc., of the London County Council service (Technology Section), has been appointed principal of the Institute, to fill the vacancy caused by the retirement of Principal C. T. Millis. Mr. Bispham will take up his duties in September.

THE NEWCOMEN SOCIETY FOR THE STUDY OF THE HISTORY OF ENGINEERING AND TECHNOLOGY.—The arrangements for the summer meeting of the Newcomen Society are as follows:—Thursday, June 1st, 10 a.m., conducted tour through the engineering collections at the Science Museum, South Kensington; 2.30 p.m., conducted inspection of Westminster Hall roof, by kind permission of Sir Frank Baines, Director of Works; 4.15 p.m., visit Clockmakers Company's horological collection at Guildhall, and, if time permits, the Guildhall; 7 p.m., dinner at Engineers' Club, Coventry-street, W. 1.; morning dress. Friday, June 2nd, 10 a.m., assemble at Institution of Mechanical Engineers, Storeys Gate, S.W. 1; 10.15 a.m., motor tour to Rotunda Museum, Woolwich, and Boulton and Watt engines, 1812 and 1824, Deptford; M.W.B. pumping station, Brookmill-road, S.E. 18, by kind permission of Mr. T. Melhuish.